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National
Aeronautics and
Space
Administration

Management of Major System Programs and Projects

HANDBOOK

Washington, D.C. 20546

MANAGEMENT OF MAJOR SYSTEM PROGRAMS AND PROJECTS HANDBOOK

PREFACE

This Handbook establishes the detailed policies and processes for implementing NMI 7120.4, "Management of Major System Programs and Projects". It constitutes a comprehensive source of the specific policies and processes governing management of major development programs/projects and is intended as a resource to the entire program/project management (PPM) community.

This Handbook is issued in loose-leaf form and will be revised by page changes.

J. R. Dailey
Acting Deputy Administrator

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CHAPTER 1

OVERVIEW

1. REFERENCE

NMI 7120.4, "Management of Major System Programs and Projects."

2. PURPOSE

The purpose of this Handbook is to establish the detailed policies and processes for implementing NMI 7120.4. It is intended to support accomplishment of program and project objectives on schedule and within budget by providing specific program/project planning, review, approval and implementation policies and processes for assuring:

- comprehensive definition (technical and management),
- adequate technology validation,
- maximum annual funding stability,
- simple organizational structures,
- realistic cost estimates,
- realistic schedules,
- acquisition strategies to promote cost containment and shorter acquisition timelines, and
- adequate mechanisms to assure control of approved program/project baselines.

3. APPLICABILITY AND SCOPE

a. This Handbook applies to NASA Headquarters, field installations, and the Jet Propulsion Laboratory.

b. This Handbook applies to program/projects for the purpose of development and operation of a major system, as detailed in NMI 7120.4. Program Associate Administrators (PAAs) shall determine how these policies and procedures should be tailored, and selectively applied, to non-major systems consistent with their size, complexity and sensitivity.

4. ORDER OF PRECEDENCE

NMI 7120.4 and this Handbook rank first and second in order of precedence for providing policies and processes for managing major programs/projects, except when statutory or regulatory requirements override.

5. USE OF "SHALL"

This Handbook uses "shall" to convey direction, i.e., "shall" statements are used for those implementing policies or processes that are mandatory. This Handbook uses "may," "will," "should," or other permissive words to convey guidance or recommendations, i.e., statements with words other than "shall" are used for those implementing policies and processes that are non-mandatory.

6. DEFINITIONS AND ACRONYMS

The definitions of terms and the listing of acronyms used in this Handbook are presented in Appendix B.

OVERVIEW/EXECUTIVE SUMMARY

1. POLICIES

a. Project Life Cycle. NASA has adopted the five-phase project life cycle illustrated in Figure 1-1 as the framework for the comprehensive management and progressive decision making associated with Project Formulation and Implementation. This standard life cycle framework facilitates the orderly translation, consistent with Agency strategic planning and cost/schedule/technical commitments, of a mission need into an operational system.

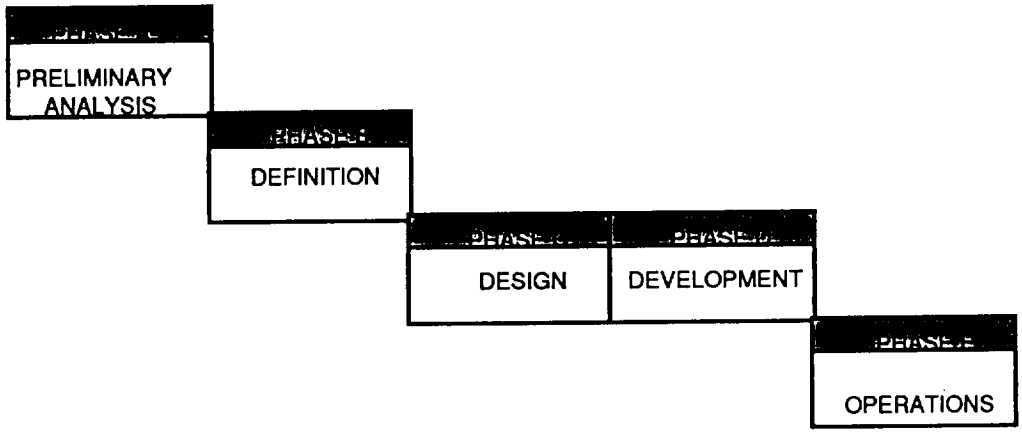

Figure 1-1 NASA Project Life Cycle

b. Integrated Planning and Management. NASA will approach effective program/project planning and management as a comprehensive and disciplined process that integrates engineering, operational, schedule, procurement, and risk factors with Agency affordability and strategic planning.

c. Decision Making and Accountability. NASA uses a "chain of contracts" concept that documents agreements between adjacent layers of management throughout all levels of management, from the Administrator to the individual project managers. These documents are designed to clearly identify the authority of their signatories and document the commitments for which each is accountable. Programmatic direction shall only be issued by the accountable persons within the chain of authority established for the program.

d. Continual Improvement. NASA's programs/projects are the most significant and visible way NASA executes its responsibilities as an agency. Excellence in the Agency's performance depends on excellence in program/project management. NASA is committed to continual improvement and to the principles of Total Quality Management. In order to measure improvement, program/project managers are responsible for the development of cost, schedule and technical metrics, in accordance with the NASA-Wide Metrics Program.

2. PROCESSES

a. Life Cycle Phase Transitions.

(1) NASA has established the transitions from one phase to the subsequent phase as key decision-making points in the project life cycle. These key decisions are based on a system's readiness to progress to subsequent phases. This evolutionary process is a disciplined way to ensure that NASA periodically validates that its projects fulfill needs consistent with NASA strategic planning, within cost and schedule constraints. Chapter 2 of this NHB details this process.

(2) Each phase of a project life cycle includes a specific set of objectives and accomplishments required to justify a determination of the project's readiness to proceed to a subsequent phase. The process and decision making authority for each phase transition are described in Chapter 2.

b. Review Forums. Independent reviews, including Non-Advocate Reviews (NARs), are performed throughout the mission lifetime and constitute the Agency's most rigorous independent assessment mechanism. A Program Management Council (PMC), chaired by the Deputy Administrator, is the Agency's senior-most review forum. The PMC formulates recommendations to the Administrator who retains program/project decision authority throughout the entire life cycle. This process is discussed in detail in Chapter 11.

c. Project Formulation (Progressive Baseline Definition).

During Pre-Phase A, advanced studies explore multiple solutions to satisfying a perceived need. These studies contribute to a broad, initial understanding of the cost/schedule/performance baselines required to satisfy the need. The development of these project baselines the results from the Project Formulation

process of successive refinement, which occurs in Phases A and B as illustrated in Figure 1-2. During Phase A (Preliminary Analysis), the mission need is defined and initial program/project management systems and processes are created to permit structured and definitive baselines to be established. Trade studies considering affordability, risk, technology content, potential procurement strategies, etc. are conducted and reflected in cost/schedule/performance baselines. During Phase B (Definition), subsequent trade-off decisions are made, and these cost, schedule and performance baselines are progressively refined. This continued refinement process results in a definitive cost, schedule and configuration baseline for Phase C or C/D. It defines a program/project that satisfies a mission need and in which NASA has enough confidence to commit to completing within prescribed budgetary and schedule constraints.

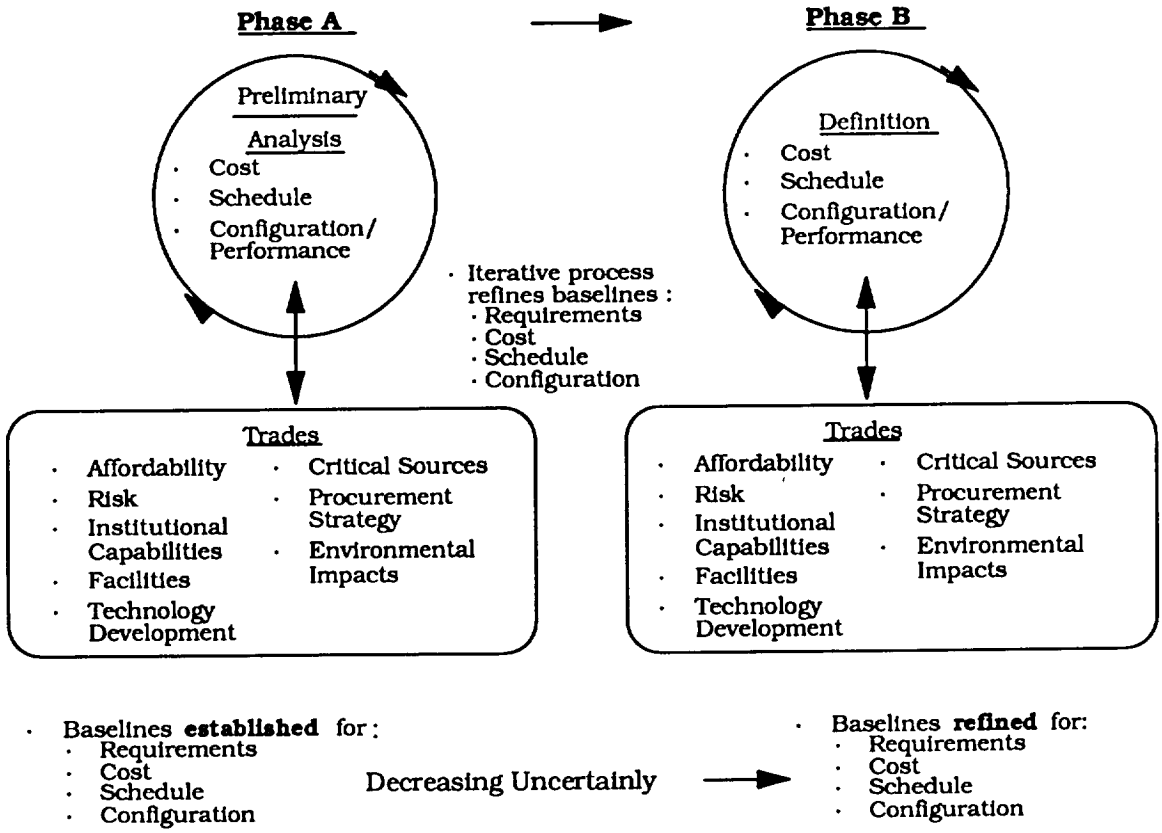

Figure 1-2 Progressive Project Baseline Refinement Throughout Formulation Phases

d. Program/Project Implementation (Baseline Control).

Programs/projects are continually monitored to ensure that they are satisfying the performance/cost/schedule objectives and constraints reflected in the established baselines. Oversight and monitoring approaches are designed and implemented to ensure that performance against these baselines is objectively assessed and anticipated breaches of baseline commitments are promptly reported and addressed. Adjustments to any of these commitments are made only through formal revisions to the commitment documents.

CHAPTER 2

LIFE CYCLE AND PROCESSES

This chapter provides an overview of the phases of the NASA program/project life cycle, the key products; reviews, and management processes that control orderly progression through the life cycle. The appendices to this chapter establish the standards for commitment documents and design reviews as follows:

APPENDIX	SUBJECT
A	Commitment Document
B	Design Reviews

CHAPTER 2

LIFE CYCLE AND PROCESSES

1. PURPOSE

This chapter defines the phases which comprise the NASA project life cycle, the key products produced during these phases, the major program/project reviews associated with these phases and the management processes which control the orderly progression throughout the life cycle.

2. POLICIES

a. Life Cycle. Major system projects shall be carried out through the five-phase, event driven life cycle process depicted in Figure 2-1, which begins with Phase A (Preliminary Analysis) and progresses through an orderly series of transitions, through Phase E (Operations). Projects shall only proceed from one phase to another in the life cycle when all prerequisites described in this Handbook have been met.

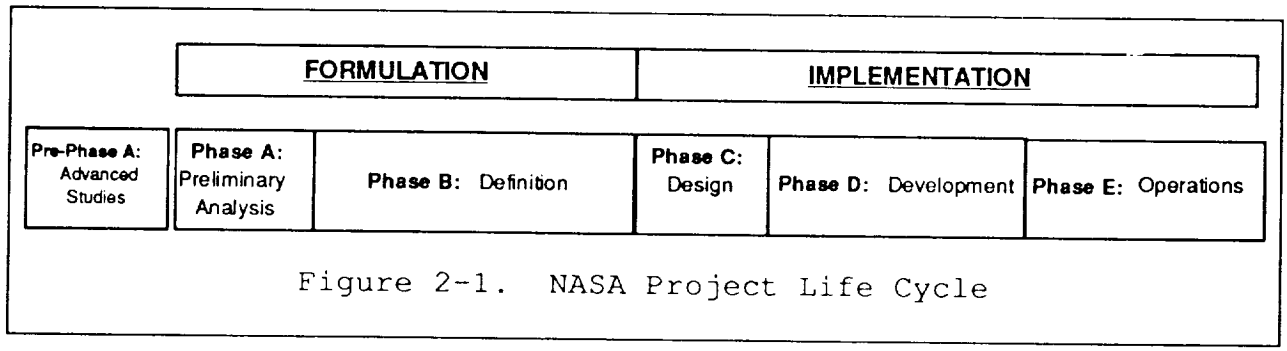

Figure 2-1. NASA Project Life Cycle

b. Management Agreement Structure. The agreements between the project manager and senior agency management shall be documented and maintained throughout the life cycle. These documents, and the respective management agreement structure, are identified in Figure 2-2.

c. Advanced Studies. Pre-Phase A, Advanced Studies, occurs prior to the initiation of the life cycle. These advanced studies support the establishment of future projects through exploring perceived needs and potential solutions to meet them.

d. Project Formulation. The first two phases of the life cycle, Phases A and B, shall be Headquarters led efforts to establish the mission need and provide a comprehensive definition of the project. These two phases comprise the Formulation portion of the life

cycle, and must be completed prior to initiating the Implementation portion of the life cycle. Proper planning during the Formulation period is essential to the successful execution of Project Implementation. Throughout Phase A and Phase B, parametric cost analyses are to be performed in order to assure that the Agency has identified the most cost effective implementation concept. Concurrently, affordability assessments are to be performed to assure that Agency financial resources and priorities support such an endeavor. In preparing a project for an Agency's implementation commitment, realistic cost estimates, together with the Agency's ability to meet such a financial commitment, shall be of major importance.

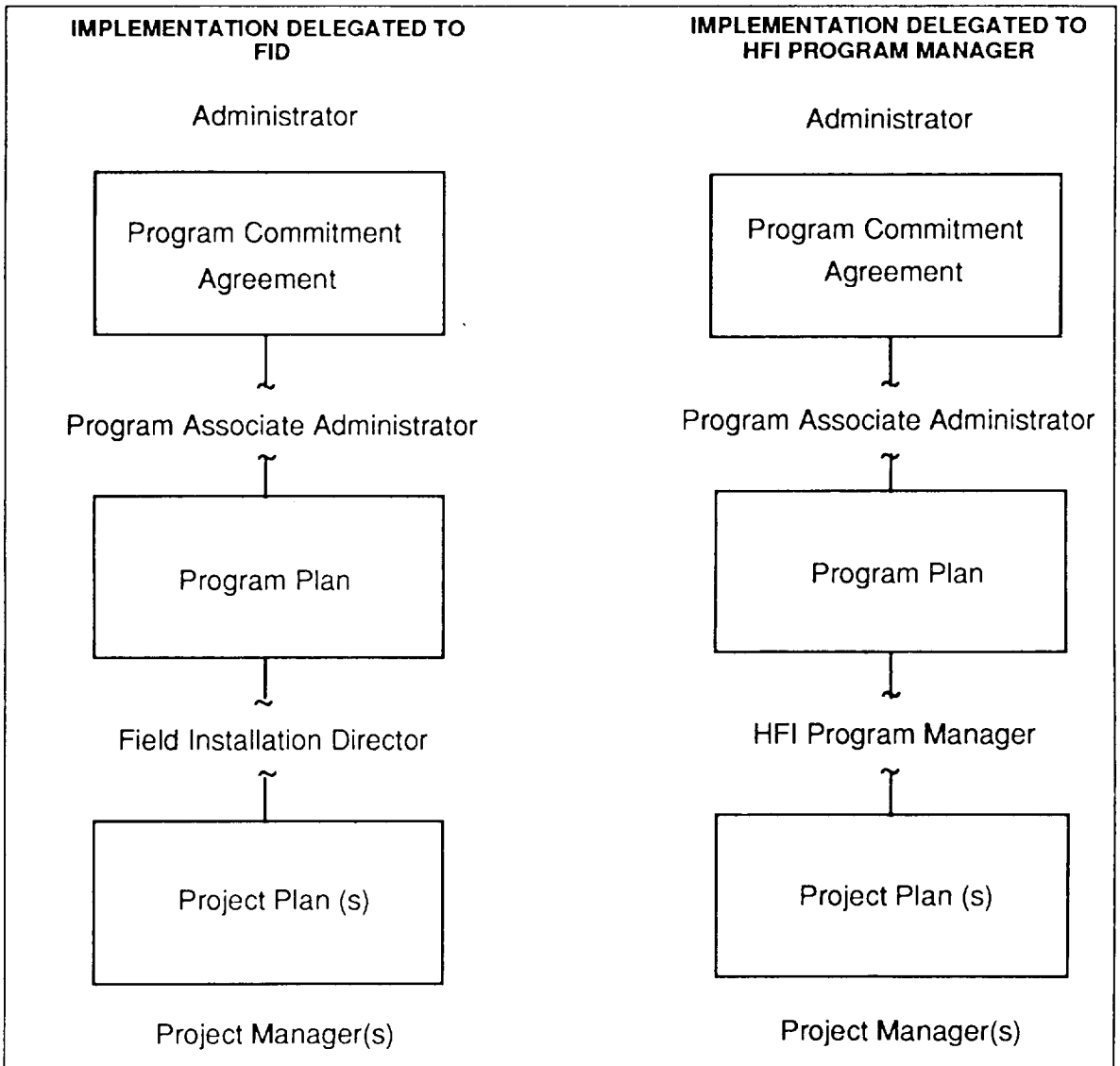

Figure 2-2. Program/Project Management Agreement Structure

e. Project Implementation. Implementation is comprised of Phase C (Design), Phase D (Development) and Phase E (Operations). During Project Implementation, the detailed design is completed and the system is fabricated and tested. Throughout the Phase C and D Implementation phases of the project, cost analyses shall be performed by the project as well as by independent analysts in order to determine adherence to cost estimates baselined during the formulation period. These dual analyses assure that program costs are being contained. Programs which exceed cost thresholds will be subject to cancellation reviews.

f. Reviews.

(1) Project Reviews

(a) Figure 2-3 identifies the significant project reviews conducted as part of the project manager's review and reporting function and identifies where the reviews occur in the life cycle. These reviews are intended to provide the project manager with the information necessary to assess progress and execute appropriate corrective action, if required. Figure 2-3 is not intended to be a comprehensive description of all reviews conducted on major projects, but rather is intended to identify the major reviews conducted in support of the project management and agency oversight objectives covered by this Handbook.

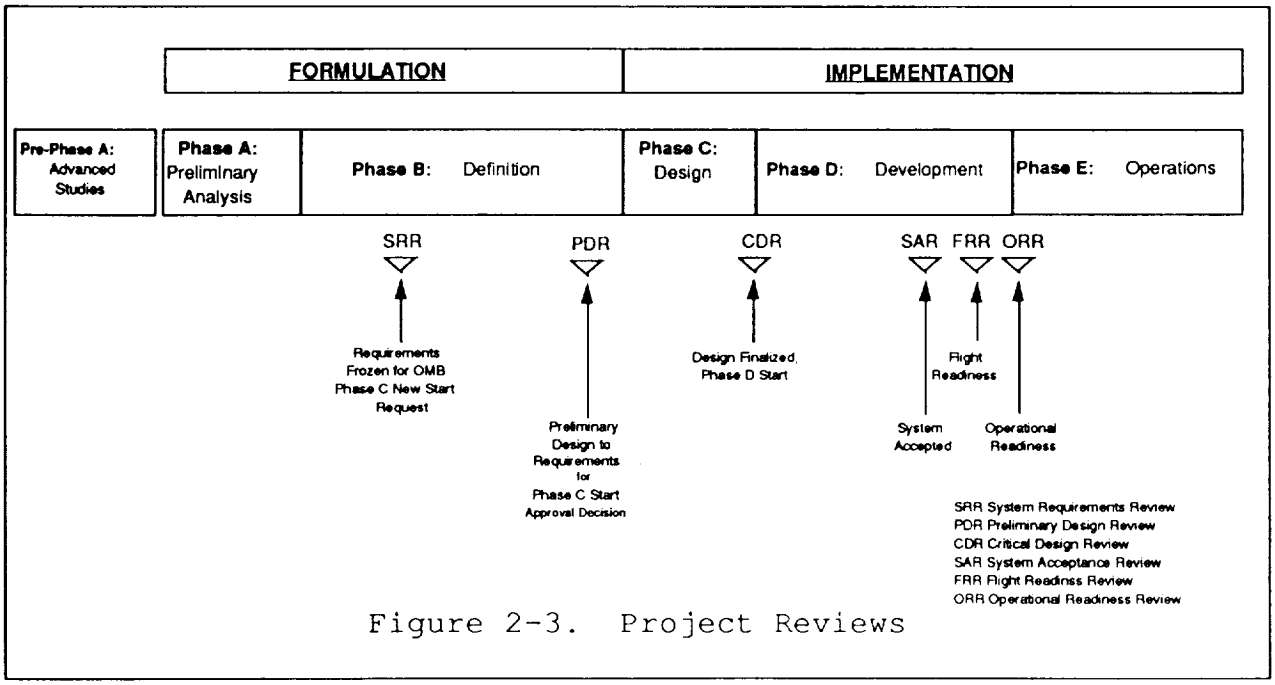

Figure 2-3. Project Reviews

(b) Of the reviews listed in Figure 2-3, the Preliminary Design Review (PDR) and the Critical Design Review (CDR) shall be required of all major programs, shall be common in purpose and objective and shall use common criteria for adequate completion throughout the Agency. The forum for achieving the functional objectives of the remaining reviews is entirely at the discretion of the project manager.

(c) The functional objectives for the reviews indicated in Figure 2-3 are listed below:

(i) System Requirements Review (SRR). Confirms that the requirements and their allocations contained in the system/segment specifications are sufficient to meet project objectives. Successful completion of the SRR freezes program/project requirements. This review leads to a formal decision by a PAA to proceed with preparations for requesting a proposal for Project Implementation.

(ii) Preliminary Design Review (PDR). Confirms that the proposed project baseline is comprehensive (meets all program-level requirements), systematic (all subsystem/component allocations are optimally distributed across the system), efficient (all components relate to a parent requirement), and represents acceptable risk. The purpose, objective, and completion criteria for the PDR are provided in Chapter 2, Appendix B.

(iii) Critical Design Review (CDR). Confirms that the project's system, subsystem, and component design, derived from the preliminary design, is of sufficient detail to allow for orderly hardware/software manufacturing, integration, and testing, and represents acceptable risk. Successful completion of the CDR freezes the design, and concludes Phase C. The purpose, objective, and completion criteria for the CDR are provided in Chapter 2, Appendix B.

(iv) System Acceptance Review (SAR). Demonstrates that the system elements

constructed for use will meet all the system requirements. This review generally leads to formal acceptance of the system by the government.

(v) Flight Readiness Review (FRR). Verifies the system elements constructed for use, and the existing support elements, such as the launch site, space vehicle and booster, are ready for launch.

(vi) Operational Readiness Review (ORR). Verifies that the operational support elements of the system are ready to support system operations. This review leads to initiation of Phase E.

(2) Agency Reviews

(a) Figure 2-4 identifies the reviews required as part of the senior agency management approval and oversight function and the authority from which these reviews flow. These reviews assure that:

(i) Proposed programs/projects are consistent with NASA strategic planning, adequately defined and within available resources; and

(ii) Are conducted in accordance with the commitments contained in Program Commitment Agreements (PCA's).

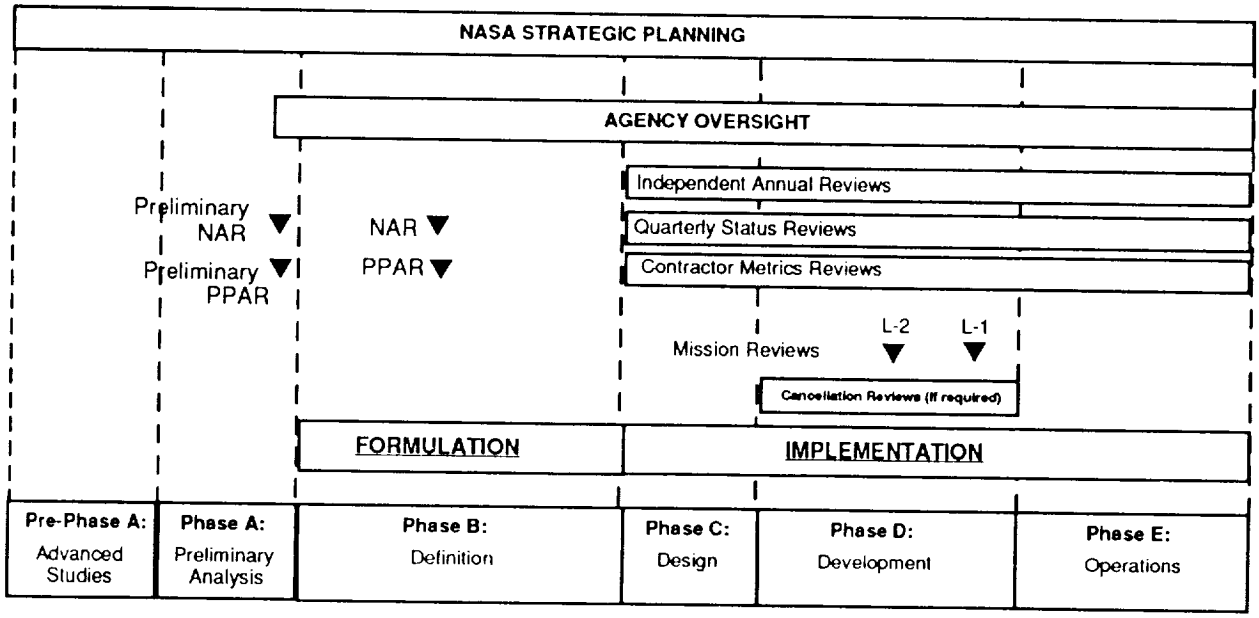

Figure 2-4. Agency Reviews

(b) The functional objectives for the reviews shown in Figure 2-4 are listed below:

(i) Non-Advocate Reviews (NAR). Provides Agency management with independent assessments of the readiness of projects to proceed to Phase B or Phase C/D.

(ii) Program/Project Approval Reviews (PPAR). Enables a Deputy Administrator/PMC recommendation for approval to initiate a Phase B or Phase C/D effort.

(iii) Independent Annual Reviews (IAR). Provides an independent verification that program/project commitments in the PCA are being met. These reviews are performed annually.

(iv) Quarterly Status Reviews (QSR). Provides quarterly status of performance, cost, and schedule against baseline.

(v) L-2 and L-1 Mission Reviews (L-2/L-1 MR). Provides the Deputy Administrator/PMC with an independent assessment of progress toward, or readiness for, mission operations. These reviews are performed at Launch minus 2 years and Launch minus 1 year

(vi) Cancellation Reviews (CR). Enables a Deputy Administrator/PMC recommendation to cancel or continue a major Phase C or Phase C/D project. A CR shall be called whenever:

a) The estimate at completion is projected, by the PAA or the CFO/Comptroller, to exceed the baseline Program Cost Commitment (PCC) or the Development Cost Commitment (DCC) Component of the PCC by more than 15 percent, or

b) Any other PCA threshold requirement contained in the PCA is projected to be violated.

(c) Figure 2-5 correlates the timing of project-internal reviews with the agency reviews in relation to the life cycle. Project reviews integrated with Agency oversight reviews

ensure sufficient content and quality to support the Agency decision-making process.

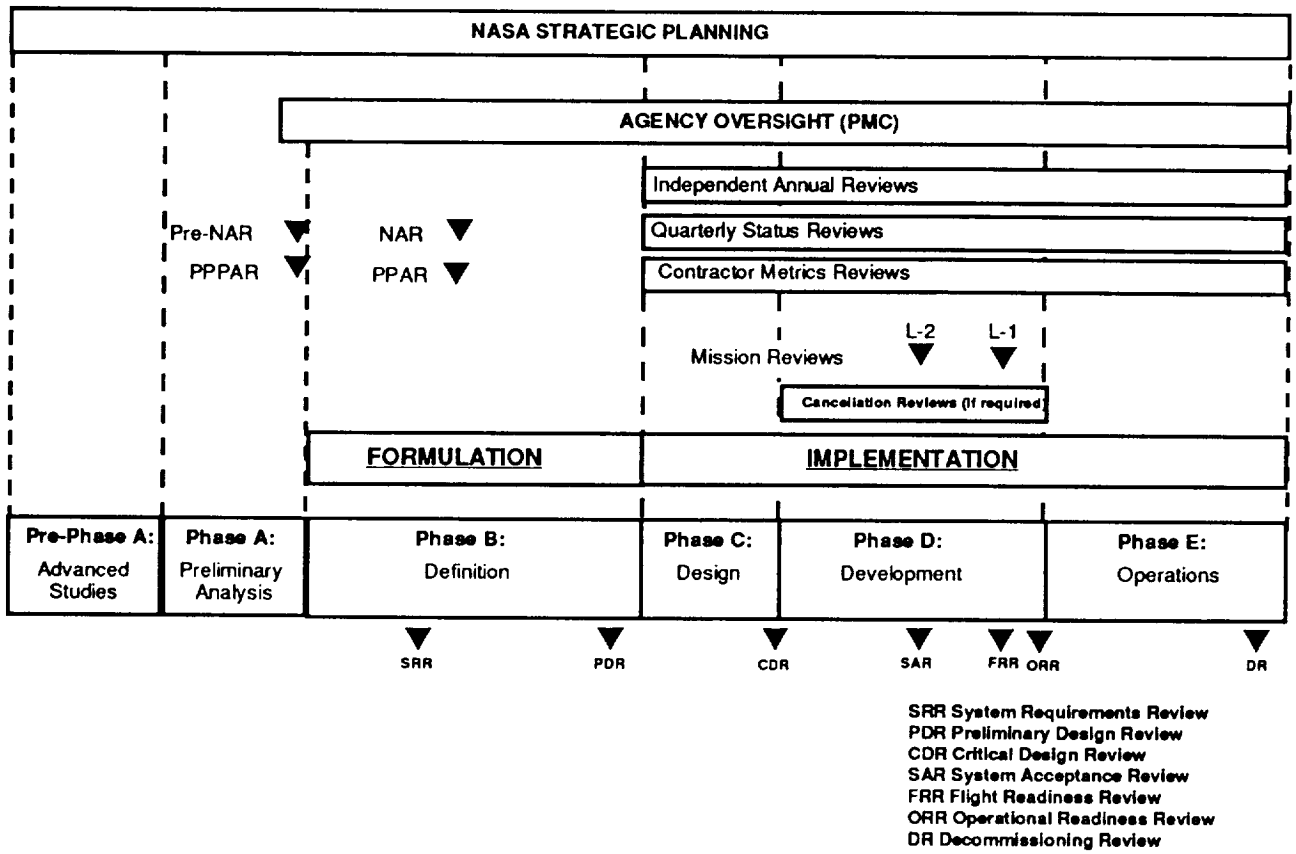

Figure 2-5. Project and Agency Reviews

(d) The relationship between some of the more significant project reviews, Agency oversight reviews, management agreements, and major decisions in relation to the NASA project life cycle is illustrated in Figure 2-6. The durations shown in Figure 2-6 are illustrative. Actual durations should be the product of deliberate project planning to satisfy the mission need and assure complete project definition prior to initiating Project Implementation.

3. PROCESSES

a. Pre-Phase A - Advanced Studies.

(1) Objective. Although not a part of the project life cycle, advanced studies serve as the first step in determining new and potentially promising missions deserving of further study.

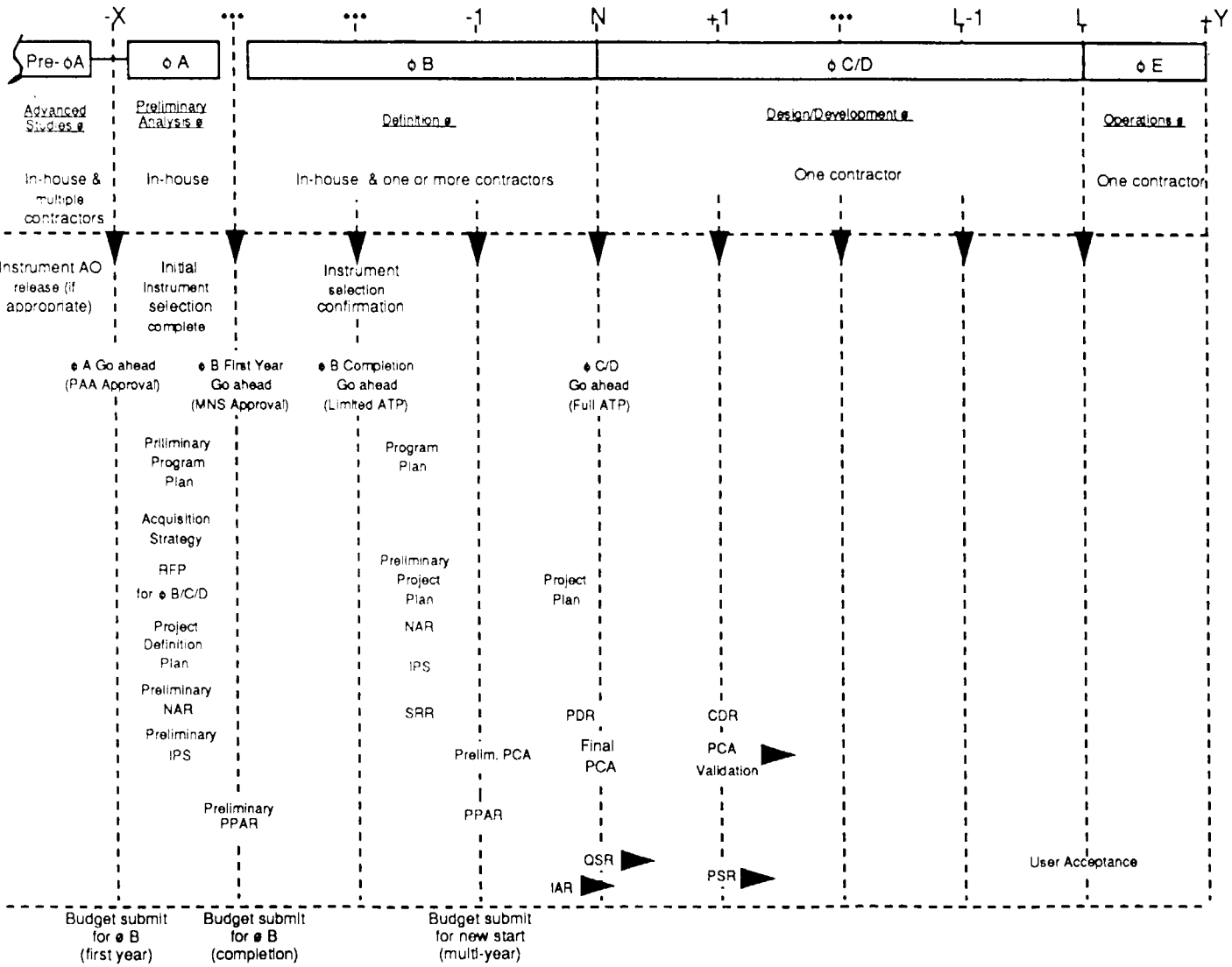

Figure 2-6. Life Cycle for Major NASA Projects

(2) Initiation. Advanced studies are authorized at the discretion of the Field Installation Director (FID) with the acknowledgment of the cognizant PAA that the planned study effort is within the framework and general scope of NASA strategic planning. The FID shall assure that resources are focused on studies of the highest priority.

(3) Implementation/Products. Advanced studies explore a wide range of potential missions or technology thrusts. To assure that the studies receive the widest possible influx of ideas and approaches, NASA encourages broad industry, university, and international involvement. Results of the advanced studies provide the basis for FIDs to determine if further study should be proposed to the cognizant PAA as a candidate Phase A effort.

b. Phase A - Preliminary Analysis.

(1) Objective. The objective of Phase A, is to determine whether a candidate technical objective or mission is needed, feasible, and compatible with NASA strategic planning. The cognizant PAA participates with the FIDs in this evaluation.

(2) Initiation. Phase A efforts for a candidate Phase C/D new start are initiated upon PAA approval of an FID recommendation or upon PAA direction to a FID. By this approval the PAA has determined that sufficient expectation exists for the candidate project to proceed to Phase B, and that sufficient Pre-Phase A efforts have been expended to assure for a successful and timely Phase A effort. The cognizant PAA will initiate Phase A by:

(a) Designating a Headquarters Program Manager or Program Director,

(b) Designating, with the concurrence of the cognizant Institutional Associate Administrator (IAA), the field installation(s) responsible for the project(s) definition and implementation,

(c) Requesting the FID(s) to initiate the Phase A effort(s), and

(d) Informing Office of Management and Budget (OMB) and Congress on the Phase A initiation decision and submitting the budget request for the first year of Phase B.

(3) Implementation/Products.

(a) The primary Phase A products, along with supporting information, are provided in Table 2-1. Figure 2-7 illustrates the Phase A activity flow.

Primary Product	Required By	Responsible Official	Highest Approval Level in Phase	Due
MNS	Administrator	Project Manager	Administrator	Preliminary NAR
Project Definition Plan	PAA	Project Manager	PAA	Preliminary NAR
Phase B/C/D RFP	PAA	Project Manager	PAA	Phase A Completion
AO	PAA	PAA	PAA	Early in Phase A
Preliminary NAR Report	Deputy Administrator	NAR Team	N/A	Preliminary PPAR
Preliminary IPS	Deputy Administrator	PAA	N/A	Preliminary PPAR
Preliminary Program Plan	PAA	PAA	PAA	Preliminary PPAR

Table 2-1. Primary Phase A Products

(b) Phase A is based on the efforts expended by the NASA field installations during Pre-Phase A in-house and contracted advanced studies, the knowledge gained from past and on-going programs, inputs from activities of various advisory structures and private sector groups, and the efforts expended by the user community. The Phase A effort will be conducted primarily by field installation staff.

(c) In certain circumstances, industry may elect to fund and complete an equivalent Phase A study on their own initiative. The PAA may consider these in conjunction with the results from other traditional Phase A studies in determining those projects worthy of further consideration for Phase B. Such industry-initiated efforts, if selected, shall result in a competitive Phase B/C/D acquisition strategy.

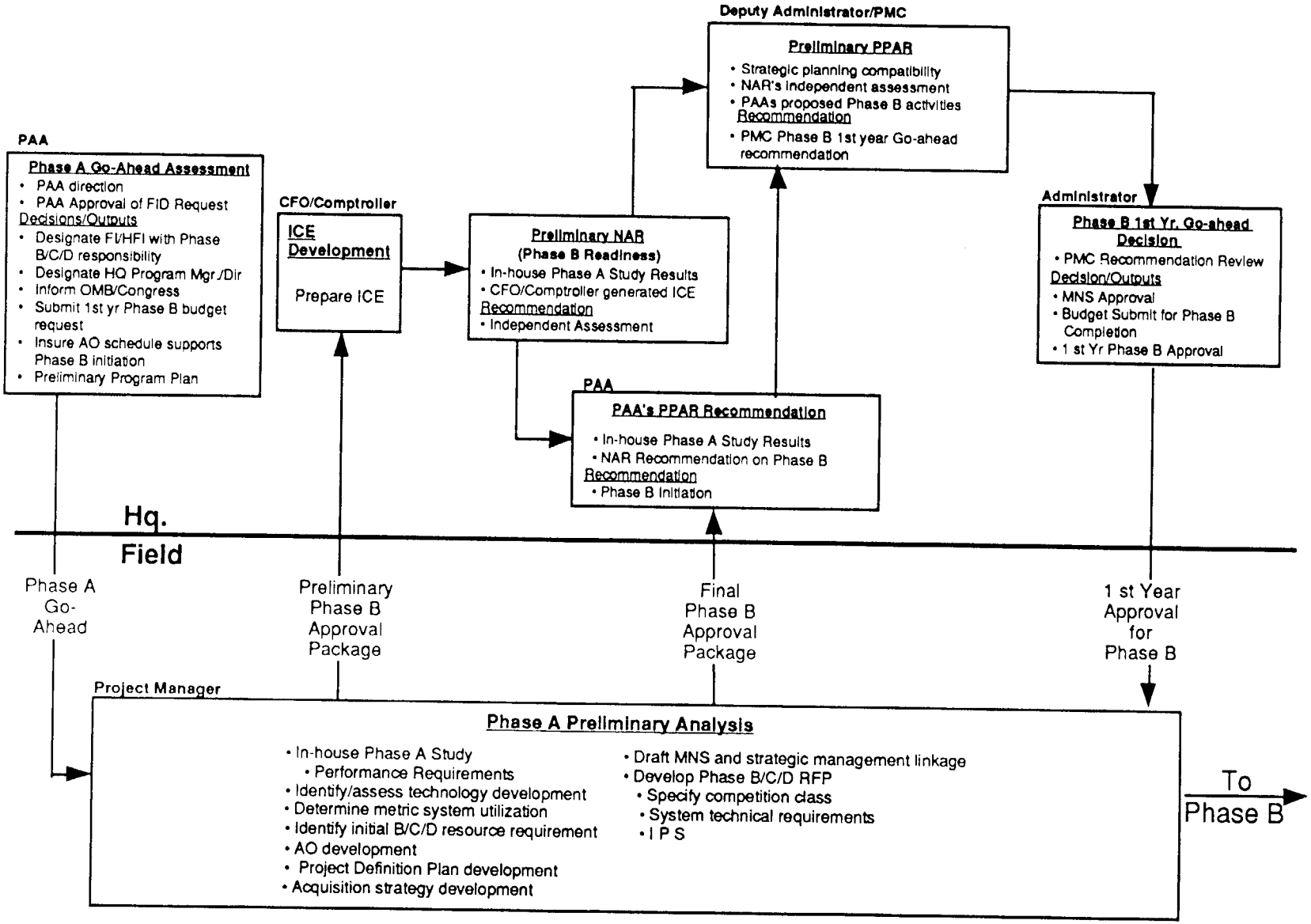

Figure 2-7. Phase A Activity Flow

(d) The Phase A effort includes the definition of mission need, development of project-level requirements and continuation of advanced technology efforts required to support the proposed need (including the continued assessment of technologies to meet requirements, and the continued development and maturation of needed technologies). This effort shall also include a determination on use of the metric system.

(e) The following formal management agreements must be developed during Phase A:

(i) Mission Need Statement (MNS). The MNS will be developed, validated with the user, and submitted to the PAA for approval by the Administrator. The mission need is generated as a result of a specific deficiency in current agency programs or capabilities with respect to NASA strategic planning. The MNS shall be prepared in accordance with Chapter 2, Appendix A.

(ii) Preliminary Program Plan. The Preliminary Program Plan defines the program-level requirements, management organization and responsibilities, and the program resources, schedule, and controls. This plan shall be prepared in accordance with Chapter 2, Appendix A.

(iii) Project Definition Plan. This document constitutes the plan for implementation of Phase B. This plan shall be prepared in accordance with Chapter 2, Appendix A.

(f) The following additional products are required outputs of Phase A:

(i) Request for Proposal (RFP) for Phase B/C/D,

(ii) Announcement of Opportunity (AO), when appropriate, issued in time for the initial instrument selection to be completed by the time of Phase B initiation,

(iii) Independent Cost Estimate (ICE), produced by the CFO/Comptroller, to

provide an independent validation of the project's cost estimate,

(iv) Preliminary NAR Report, produced by an independent team, to provide an independent validation of the project's proposed implementation of the requirements, and

(v) Preliminary Integrated Program/Project Summary (IPS), provided by the PAA, to summarize program/project structure, status, assessment, plan and recommendations. The Preliminary IPS shall be prepared in accordance with Chapter 11, Appendix 3.

(g) Both the MNS and the RFP must be supported with documentation which describes the results and findings of both Pre-Phase A and Phase A studies, and provides confirmation that the proposed technical implementation approaches and periods are the minimum necessary to meet the mission need.

(h) Near the end of Phase A, a Preliminary NAR will be conducted to assess readiness to proceed to Phase B. As part of the Preliminary NAR, an ICE will be generated by the CFO/Comptroller. Both the in-house Phase A study team results and the results of the Preliminary NAR will be presented to the cognizant PAA for a decision whether or not to request a Preliminary PPAR.

(i) PAAs will identify and prioritize their respective new Phase B candidates based on the results of the Phase A studies and in consultation with the cognizant FIDs. PAAs will then review their candidates with the PMC for endorsement. The Council's endorsement is to be on the basis of its determination that:

(i) The candidate is compatible with NASA strategic planning and the Agency fully intends to proceed to the initial phase of project implementation (Phase C) at the completion of the Phase B effort,

(ii) All Phase A requirements have been satisfactorily met, and

(iii) The projected implementation resource requirements (program and institutional)

can be accommodated within expected Agency resources.

c. Phase B - Definition.

(1) Objective. The objective of Phase B is to thoroughly define the program/project requirements and to provide sufficient detail definition of the project technical, management, budget and institutional support plans to enable a firm Agency commitment to accomplish the project objectives on schedule and within budget.

(2) Initiation. The Administrator's approval of the MNS for a candidate shall constitute approval to proceed to Phase B. All candidates approved by the Administrator shall be reviewed with the OMB and Congressional staffs in a timely manner. These reviews should support the Agency budget request for the efforts required for the candidates beyond the first year of this phase.

(3) Implementation/Products.

(a) The primary Phase B products along with supporting information are provided in Table 2-2. Figure 2-8 illustrates the Phase B activity flow.

(b) The Phase B effort will be conducted in accordance with the Project Definition Plan and will be based on the MNS, the performance requirements contained in the RFP, supporting Phase A results and the results of continuing technology development and maturation efforts to support readiness of required technologies. The majority of the effort will normally be accomplished by contract, although NASA will conduct a parallel in-house effort to validate the contracted effort and to prepare the field installation project management team to perform the project technical and management functions during Phase C/D.

(c) A PDR will be conducted near the end of Phase B. The requirements, along with the cost estimates and project implementation schedule, should be in sufficient detail to establish a firm technical, schedule and cost baseline for the project. This baseline provides the basis for finalizing the Project Plan prior to start of Phase C/D.

Primary Product	Required By	Responsible Official	Highest Approval Level in Phase	Due
Reaffirmed MNS	Administrator	PAA	Administrator	End of Phase B
Preliminary Project Plan	PAA	Project Manager	PAA	NAR
Preliminary PCA	Deputy Administrator	PAA	N/A	NAR
PCA	Administrator	PAA	Administrator	PPAR
SRR System Spec	PAA	Project Manager	N/A	PPAR
PDR Baseline	PAA	Project Manager	N/A	End of Phase B
Contractor Selection Decision	Project Manager	Source Evaluation Board	Source Selection Official	Prior to Phase B Completion
Instrument Selection Decision	PAA	PAA	PAA	Early Phase B
NAR Report	Deputy Administrator	NAR Team	N/A	PPAR
Project Plan	PAA	Project Manager	PAA	End of Phase B
PCA	Administrator	PAA	Administrator	Annually
IAR Report	Administrator	CFO/ Comptroller	NAR	Annually
IPS	Deputy Administrator	PAA	N/A	PPAR
Final Program Plan	PAA	PAA	PAA	PPAR

Table 2-2. Primary Phase B Products

(d) A set of multiple descope proposals generated by the project office shall be included in the baseline. These descope options shall include both reduced mission scopes, along with their respective reduced systems requirements, which correspond to a mission and system constrained by reduced resources. The descope plans shall be systematic, identifying reduced systems capability against reduced mission objectives, and shall identify a threshold below which no efficient mission would be possible. This threshold

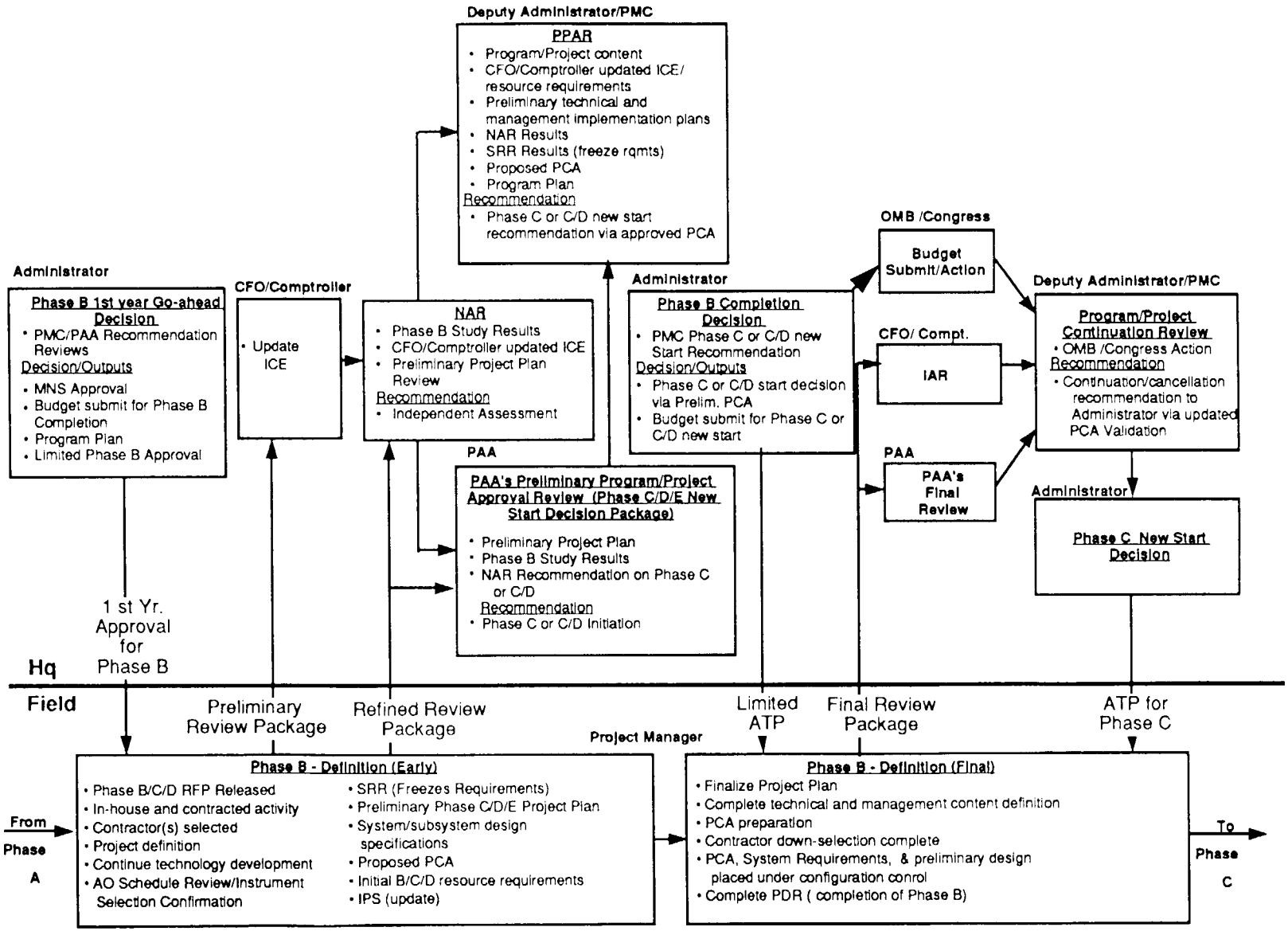

Figure 2-8. Phase B Activity Flow

defines a system's minimum acceptable functional and performance characteristics necessary to satisfy the mission objective.

(e) If changes are necessary to the established PDR baseline, a formal configuration control procedure must be utilized.

(f) The following formal management agreements must be developed or updated during Phase B:

(i) Mission Need Statement (MNS) will be reaffirmed,

(ii) Project Plan for implementation of Phase C/D prepared in accordance with Chapter 2, Appendix A. A Preliminary Project Plan will be developed early in Phase B, and then finalized at the conclusion of Phase B,

(iii) Program Commitment Agreement (PCA), prepared in accordance with Chapter 2, Appendix A. A Preliminary PCA shall be prepared to be available at the PPAR. Preparation of the PCA will be coordinated with the CFO/Comptroller prior to submittal.

(g) The following additional products are required outputs of Phase B:

(i) SRR System Specification, which includes a formal flow down of the project-level performance requirements (as documented in the RFP) to a complete set of system and subsystem design specifications. The system requirements shall be frozen at SRR.

(ii) PDR Baseline, which includes the corresponding preliminary designs (developed in accordance with the Class 1 or Class 2 competition),

(iii) Contractor Selection Decision (see Chapter 4, Acquisition Management),

(iv) Instrument Selection Decision (if applicable), and

(v) NAR Report including an ICE produced by the CFO/Comptroller to provide an independent validation of the project's cost estimate.

(h) Upon Agency receipt of Limited Authority to Proceed (ATP) from Congress, the program/project will proceed with development of products sufficient to conduct a NAR (including an ICE) and a PPAR. Successful completion of these milestones is a prerequisite for the Agency to request Full ATP. These reviews assure that:

(i) All Phase B requirements have been satisfactorily met, and

(ii) The implementation resource requirements proposed for OMB submittal are valid and within the expected agency resources.

(i) The PPAR is in the form of a Phase C/D start decision presentation to the PMC. This presentation will include the results of the NAR and the SRR and be accompanied by the Preliminary PCA and the Preliminary Project Plan.

(j) Following PMC endorsement, the Administrator's approval will be obtained through approval of the Preliminary PCA. The PCC contained in this approval will be submitted to OMB in the Agency budget request thus seeking Administration approval of the new Phase C/D start. After submission to the OMB, all program-level requirements and the PCA will be frozen and placed under configuration control.

(k) The final year of Phase B comprises the period between submittal of the new Phase C/D start approval request to OMB (usually by September 1 of the year before the fiscal year being budgeted) and Congressional approval of the budget (usually the late summer/fall before the budget year). This period will be used to complete:

(i) Comprehensive definition of the technical and management content of the project, preliminary design and finalization of all project and lower level plans, and

(ii) Final down-selection to a single contractor (if not previously accomplished)

(l) Upon receipt of Congressional approval of the

budget, the PAA will determine the impact on the Preliminary PCA of any change in the budget from that submitted and of any accompanying Congressional direction that changes program content or implementation plans. These impacts and corresponding revisions to the Preliminary PCA and other elements of the program will be prepared and presented to the Deputy Administrator/PMC. The PMC will then develop a recommendation to the Administrator as to whether to proceed with a revised program/project compatible with the approved budget or to proceed with cancellation. The Preliminary PCA and other elements of the program/project will be updated as necessary to reflect the Administrator's decision. The Administrator's signature on the revised PCA concludes Phase B and establishes the PCA that governs Phases C/D/E.

d. Phase C - Design.

(1) Objective. The objective of Phase C is to complete the detailed design.

(2) Initiation. Approval to initiate Phase C (or Phase C/D) shall be obtained through Administrator approval of the PCA and PAA approval of the final Project Plan. These approvals are prerequisites to the release of Phase C/D funding.

(3) Implementation/Products.

(a) The primary Phase C products along with supporting information, are provided in Table 2-3. Figure 2-9 illustrates the Phase C activity flow.

(b) Phase C consists of detailed system design with mock-ups and test articles of critical systems and subsystems. Phase C is normally combined with Phase D, but shall be performed separately if a large production quantity is planned. During Phase C, the project/contractor team will maintain systems development within the established performance, schedule and cost parameters.

(c) Throughout the Phase C period, the baseline preliminary design is evolved to the completion of the detailed baseline design at the CDR level. The user or user's representative continues to interact with the project office to participate in the trade-

offs necessary to refine system and product specifications and to assure that test procedures properly verify performance requirements. The CDR milestone will include a comprehensive validation process necessary to assure that all derived requirements and specifications properly represent the program and project requirements. The completion of the CDR marks the conclusion of Phase C.

Primary Product	Required By	Responsible Official	Highest Approval Level in Phase	Due
Validated PCA	Administrator	PAA	Administrator	Annually
CDR Specs/ Baseline	PAA	Project Manager	N/A	End of Phase C
PSR	Congress	PAA	Administrator	Semi-annually
CMR	Administrator	Project Manager	PAA	Quarterly
QSR	Deputy Administrator	Project Manger	PAA	Quarterly
IAR Report	Administrator	CFO/ Comptroller	N/A	Annually

Table 2-3. Primary Phase C Products

(d) All the management agreements in effect at the conclusion of Phase B are the operative documents for the implementation of Phase C. These documents shall be maintained throughout Phase C. This shall include an annual revalidation of the PCA.

(e) The following additional products are required outputs of Phase C:

(i) CDR Baseline, including:

a) Detailed CDR-level system and component specifications,
b) A CDR-level Systems Baseline Description describing the resultant systems level design, and

c) CDR-level requirements traceability establishing the linkage of all derived requirements to parent requirements and assuring that no orphan requirements exist.

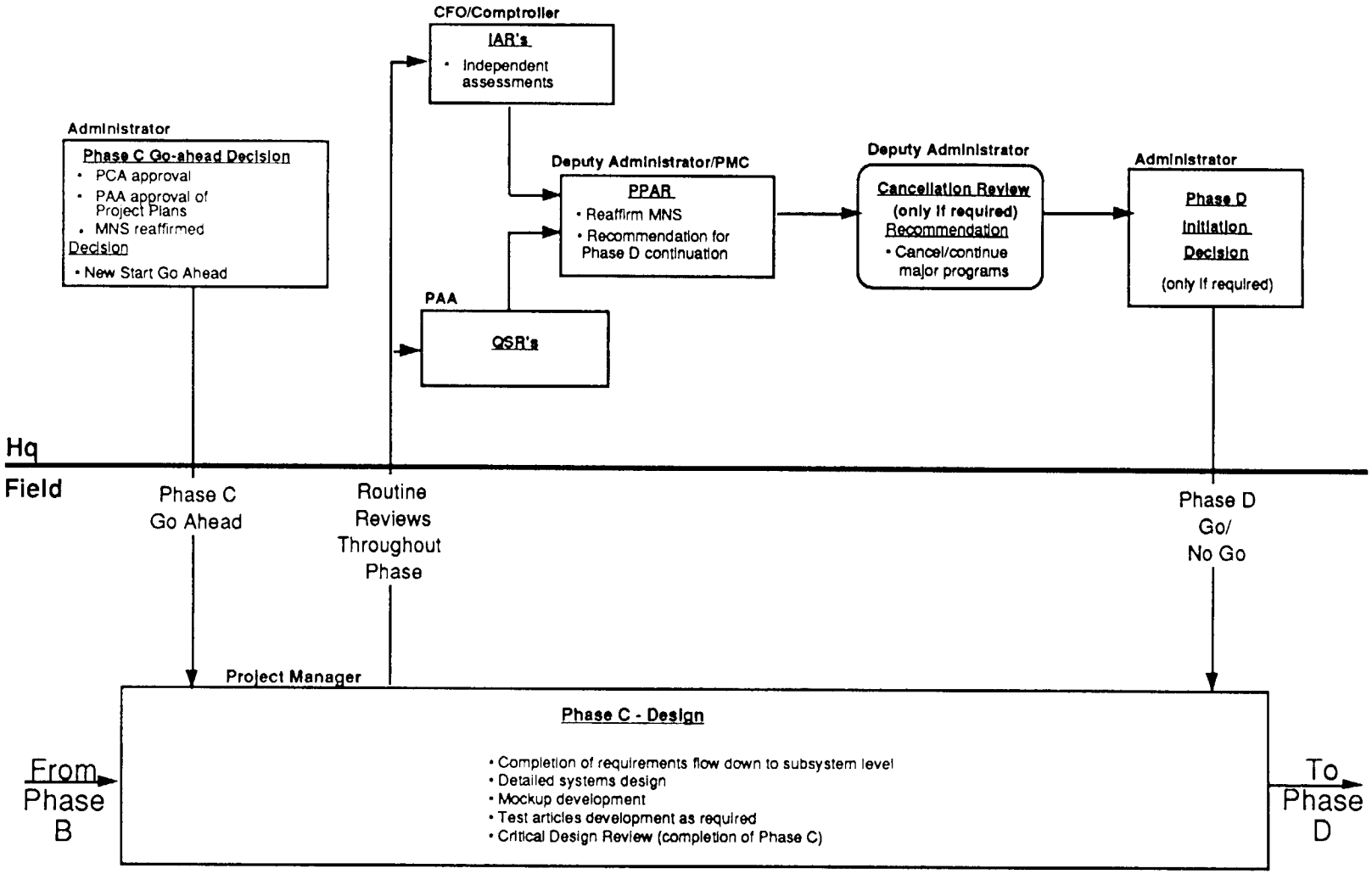

Figure 2-9. Phase C Activity Flow

(ii) Project Status Reports (PSR's),

(iii) Contractor Metrics Reports (CMR's), if required, and

(iv) Quarterly Status Reports (QSR's).

e. Phase D - Development.

(1) Objective. The objective of Phase D is to develop the system hardware and software and provide an operational system that satisifies the PCA and is accepted by the ultimate user.

(2) Initiation. For those programs/projects which include full scale production of multiple units and require implementation of Phase D as a discrete phase, Phase D efforts shall not be initiated until the Administrator has reaffirmed the mission need and system performance has been adequately tested and evaluated. Approval prerequisites consist of a revalidation of the MNS and PCA, and the endorsement of the PMC. The Administrator's approval shall be formally documented.

(3) Implementation/Products.

(a) The primary Phase D products along with supporting information, are provided in Table 2-4. Figure 2-10 illustrates the Phase D activity flow. All the management agreements in effect at the conclusion of Phase C are the operative documents for the implementation of Phase D. These documents shall be maintained throughout Phase D. This shall include an annual revalidation of the PCA. Throughout the conduct of Phase D, all reports will continue as in Phase C.

(b) Phase D comprises the fabrication, integration, certification and testing of all system hardware/software required to provide for Phase E initiation and recurring operations. Throughout system development, testing procedures or, as appropriate, engineering analysis will be employed at every level of systems synthesis in order to assure that the fabricated system components meet their requirements. This will include verification that the end-to-end system meets the total system requirements.

Primary Product	Required By	Responsible Official	Highest Approval Level in Phase	Due
PCA Validated	Administrator	PAA	Administrator	Annually
Multiple Unit Production Authorization	Administrator	N/A	Administrator	Per Phase C/D/E Program Plan
PSR	Congress	PAA	Administrator	Semi-annually
CMR	Administrator	Project Manager	PAA	Quarterly
QSR	Deputy Administrator	Project Manger	PAA	Quarterly
IAR Report	Administrator	CFO/ Comptroller	N/A	Annually
L-2/L-1 MR Reports	Administrator	PAA-appointed Team	N/A	Launch - 2 yrs/1 yr.
Operational System	PAA	Project Manager	N/A	End of Phase D

Table 2-4. Primary Phase D Implementation Products

(c) Initial flight test activities shall include deployments, engineering evaluations, and operational acceptance characterizations. The characterization testing is intended to ascertain the performance of the overall system in its operational environment. For this purpose, the total end-to-end system (institutional and mission unique) will be exercised as it relates to meeting all project-level requirements. The metrics derived from these tests may be used to establish award fee to the mission contractor.

(d) During Phase D, the PMC shall review the PCA annual validation and may request such additional reviews as required to ensure conformance to the PCA. In addition, the Phase D effort shall include two MR's conducted at approximately two (L-2) and one (L-1) years before launch or the equivalent system delivery date. These reviews are to be conducted by an independent group of experts in order to assess and determine operational readiness of the system to safely conduct the mission and to meet the user performance requirements.

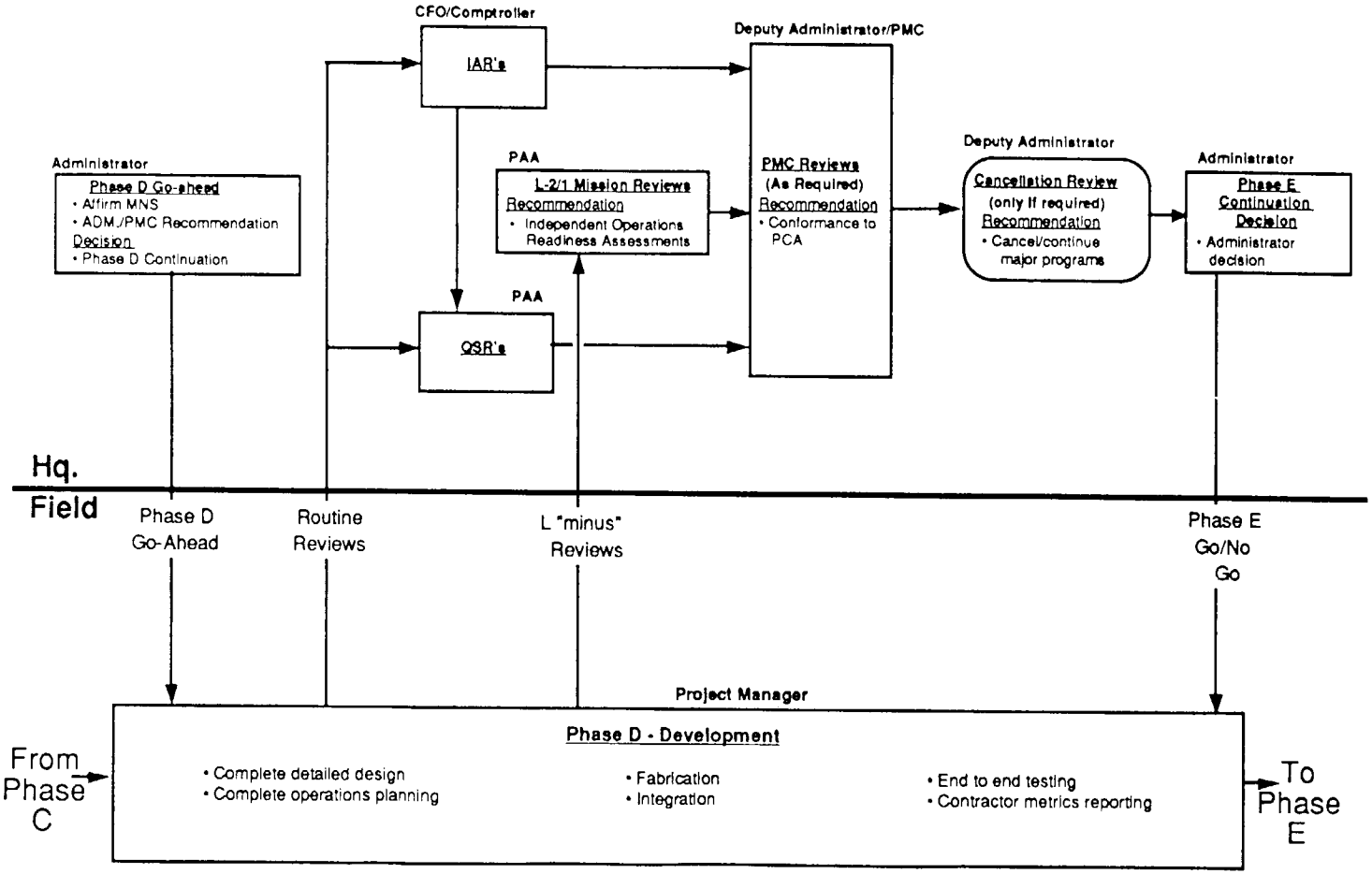

Figure 2-10. Phase D Activity Flow

f. Phase E - Operations.

(1) Objective. The objective of Phase E is to satisfy the mission need.

(2) Initiation. Phase E commences with delivery of the system to the ultimate operator/user for use in its intended environment.

(3) Implementation/Products. Figure 2-11 illustrates the Phase E activity flow. These activities include:

(a) Routine operations of the ground and flight systems necessary to conduct the mission, including, but not limited to, the following activities:

(i) Logistics support as required for the life of the system in accordance with NMI 7500, "Acquisition Logistic Policy",

(ii) Sustaining engineering, and

(iii) Any additional hardware or software development required by the Project Plan.

(b) At the discretion of the PMC, the project may be reviewed quarterly throughout the life of the mission, for such activities as useful service lifetime, user service availability, and/or reliability as they compare to the respective requirements, or other performance metrics to document "lessons learned".

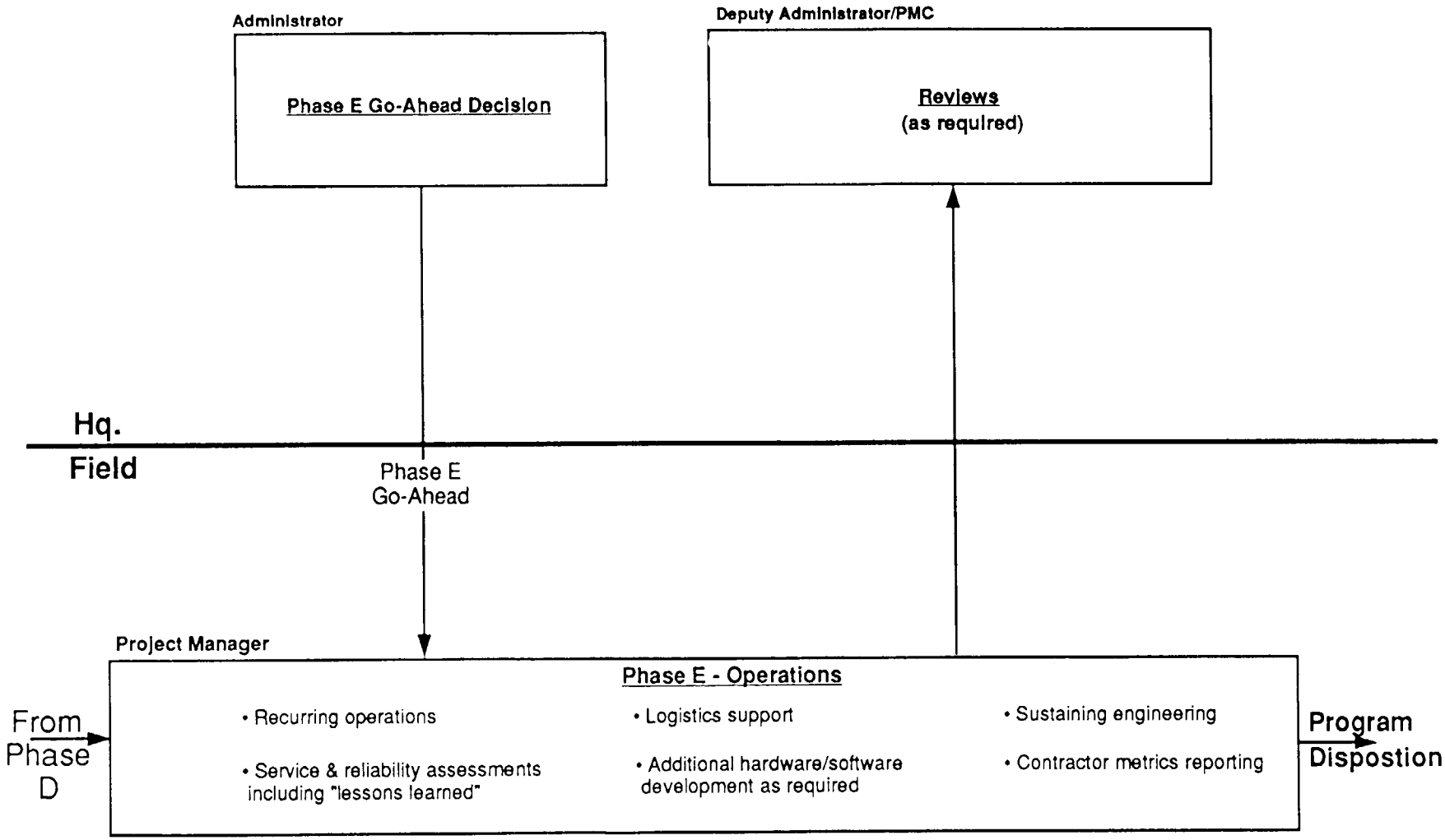

Figure 2-11. Phase E Activity Flow

CHAPTER 2

APPENDIX A: COMMITMENT DOCUMENTS

This Appendix establishes the format and content for the following basic commitment documents associated with major programs/projects:

MISSION NEED STATEMENT

PROGRAM COMMITMENT AGREEMENT

PROGRAM PLAN

PROJECT PLAN

All documents shall be prepared on NASA letterhead in accordance with these prescribed formats. In addition, it is also required that the PCA not exceed 3-4 pages in length.

Major System Acquisition Mission Need Statement

(Provide a title for the candidate program and designate a short title or proposed acronym in parenthesis if appropriate.)

Agreements:

_____ _____

Program Associate Administrator Date

_____ _____

Administrator Date

Title Page

MISSION NEED STATEMENT

(PROGRAM TITLE)

1. MISSION PURPOSE.

   Identify the mission purpose and state the need to be filled in terms of NASA strategic planning and the mission (program/ project) to be accomplished. The mission need is independent of any particular system or technological solution and shall be stated in terms of functional capabilities.

2. VALUE OR WORTH OF MEETING NEED.

   Assess the scientific or technical value or worth of meeting the need and any additional benefits to be derived.

3. RELATIVE PRIORITY.

   Indicate the priority of commencing the mission in relation to the time the mission opportunity presents itself.

4. CAPABILITY ASSESSMENT.

   Assess the need in terms of an existing science, technology, or applications deficiency, projected physical obsolescence, cost saving opportunity, or environmental impact. Identify any existing capability to accomplish the mission.

5. CONCEPT/APPROACH.

   Indicate, including supporting rationale, if this is considered to be a Class 1 or 2 mission need concept. (A Class 1 is the determination that the potential exists for an alternative system design concept procurement, and Class 2 is the determination that only a single system design concept is to be pursued.)

6. SYSTEM ELEMENTS/COMPONENTS.

   Identify all elements/components that make up the major system acquisition.

7. FUNDING.

   Identify, by fiscal year, the funding that the agency would be required to commit for Phases B, C/D, (i.e., the DCC component of the PCC) and E. For programs planned to be operated for many years, the operations cost shall be expressed in terms of anticipated annual operating expense. Indicate confidence in the validity of the availability of such funding.

Resources (NOA)	FY1	FY2	FY3	FY4	FY5	•••	FYn	TOTAL
Phase B								
Phase C & D								
Phase E								
Total								

8. PRIOR STUDIES DOCUMENTATION.

Briefly summarize the results of prior studies that were performed which support this major system acquisition. Identify by reference the study documentation.

9. AGENCY COMPONENTS INVOLVED.

Identify the Agency components (program office, project office, etc.) to be involved in the mission and their roles and responsibilities.

10. TIME CONSTRAINTS.

Indicate the time constraints impacting the accomplishment or start of the program requirement.

11. OPERATING CONSTRAINT.

Outline the operating constraints that would impact the successful implementation of the mission (capabilities, facilities, outside agreements, commitments, etc.)

Program Commitment Agreement

[Provide a title for the candidate program and designate a short title or proposed acronym in parenthesis if appropriate.]

It is the responsibility of each of the signing parties to notify the other in the event that a commitment cannot be met, and to initiate the timely renegotiation of the terms of this agreement.

Agreements:

Program Associate Administrator	Date
Administrator	Date

PROGRAM COMMITMENT AGREEMENT

(PROGRAM TITLE)

1. PROGRAM OBJECTIVES.

This paragraph should convey the following:

- The broad program objectives in plain English.
- The public good of the program to the taxpayer stated in a way that can be understood by the average taxpaying citizen.

2. PROGRAM OVERVIEW.

This paragraph should provide a broad description of the strategy to achieve the above mentioned objectives while retaining the flexibility of the PAA in implementing the program.

3. TECHNICAL AND SCHEDULE COMMITMENTS.

This section should provide:

(1) A high-level description of the technical capability resulting from the activity, e.g., an expendable launch vehicle capable of delivering 20,000 lbs. to a 300 nautical mile circular orbit at 28.5 degrees inclination. The threshold requirements for the technical capability, i.e., the requirements which, if not met, would result in the basic mission objective not being satisfied, shall also be defined.

(2) Key milestones, e.g.

(a) Launch date of each spacecraft, launch date for a vehicle first flight, first element launch;

(b) Minimum period of operation of each spacecraft;

(c) Date on which validated science results will be archived for use by the general science community or when user services would be made available to the user community.

4. RESOURCE COMMITMENTS.

This section contains the PCC and its component elements presented in the format shown in Figure 2-A-1. These commitments shall be specified in accordance with the definitions of Figure 2-A-1 and Appendix A of this instruction and with the following:

PROGRAM COST COMMITMENTS (PCC), $M FOR XYZ PROGRAM								
COST COMMITMENT CATEGORIES		FY 1	FY 2	FY 3	....	FY N	Totals	Responsible AA Signature
DEVELOPMENT (DCC)	Phase B	xxx					xxx	PAA
	Phase C/D	xxx					xxx	
	Totals	xxx					xxx	
OPERATIONS								
	Phase E	xxx					xxx	
	Totals	xxx					xxx	
OTHER	CofF	xxx					xxx	SAA #1
	Launch Vehicle	xxx					xxx	SAA #2
	Tracking and Data	xxx					xxx	SAA #3
	etc.							...
	etc.							SAA #N
	Totals	xxx					xxx	
	Totals (PCC)	xxx					xxx	

Figure 2-A-1
Program Cost Commitment Format and Content

(1) All resources through the end of nominal mission lifetime shall be included, i.e., through prime mission.

(2) The Construction of Facilities (C of F) resources shall include all resources required to construct, modify or outfit facilities to satisfy the system technical and schedule commitments.

(3) The launch vehicle related resources shall include the launch vehicle, launch site, and any project unique launch vehicle related resources necessary to satisfy the system technical and schedule commitments.

(4) The tracking and data resources shall include all project-unique tracking and data acquisition capabilities and services necessary to satisfy the system technical and schedule commitments

5. PROGRAMMATIC RISK.

This paragraph should identify areas of exceptional risk (technical, programmatic, supportability, cost, and schedule) where failure in one or more of those areas might expose the Agency to adverse social or political consequences and/or result in an extreme negative programmatic impact (examples of risk areas might be planetary launch windows, launch of nuclear power sources, etc.). This section should also identify the actions taken to mitigate the risks.

6. INTERNAL NASA AGREEMENTS.

This paragraph should contain a brief overview of the NASA internal agreements necessary to meet the commitments, and should reference those agreements which provide the details of the required support. Consideration should be given to all support commitments; as, for example:

1. C of F
2. Provision of launch vehicle and launch site
3. Tracking and data acquisition
4. Any other technical or institutional support

There shall be a one for one correlation of the items referenced above with the items identified in Section 4.

Project plans with NASA field installations including civil service workforce level commitments should be included (concurrence of the IAA is required if outside the implementing PAA authority). Supporting field installation workforce levels are to be identified in the Program Plan.

7. EXTERNAL AGREEMENTS.

This paragraph should list all the inter-agency and international agreements necessary to meet the commitments.

8. PCA ACTIVITIES LOG.

This section shall contain a log of all activities associated with maintenance of the PCA including the annual revalidations and all deviations to the original PCA. This log shall be in the format shown below, and shall be supplemented with an addendum for each change, which describes the change, and is attached to the PCA.

PCA ACTIVITIES LOG (SAMPLE)

Date	Event	Change	Addendum	Cancellation Review Req'd	PAA Signature	Administrator Signature
dd/mm/94	Annual Revalidation	None	N/A	No		
dd/mm/95	Annual Revalidation	None	N/A	No		
dd/mm/96	POP 96 reduced FY97 by $15M	Deleted Real-time Data Products to Users	Ref. #1	No		

Program Plan

[Provide a title for the candidate program and designate a short title or proposed acronym in parenthesis if appropriate.]

Agreements:

Program Associate Administrator	Date
Program Director (If Applicable)	Date
Field Installation Director or HFI Program Manager	Date

Title page

PRELIMINARY PROGRAM PLAN
OR
PROGRAM PLAN

PROGRAM PLAN
(PROGRAM TITLE)

1. INTRODUCTION.

Briefly state the background of the program and its current status, including the results of Pre-Phase A and Phase A activities, decisions, and documentation such as the MNS.

State that the main purposes of this Program Plan are to establish:

(1) Program objectives,

(2) Program-level requirements,

(3) The management organizations responsible for the program throughout its life cycle.

(4) Program-level resources, schedules, and controls.

Briefly summarize the scope of the information covered in the remaining sections.

2. PROGRAM OBJECTIVES.

State program objectives and their relationship to NASA program goals as set forth in NASA strategic planning.

3. PROGRAM-LEVEL REQUIREMENTS.

Define the program-level requirements. For multiple projects within a program, describe the way in which program level requirements will be allocated to the respective projects.

4. PROGRAM ELEMENTS AND ORGANIZATIONAL RESPONSIBILITIES.

Briefly describe the major components of the program and how they will be integrated together; including how the program will relate to other institutions within NASA as well as outside of NASA. Identify the responsibilities of each field installation as they relate to their respective requirement allocations referenced in paragraph 2 above. Describe the overall architecture of the program.

a. Organization.

Describe the NASA organizational structure for managing the system program and projects from the PAA to the

field installation project managers. Include lines of authority, coordination, and reporting; illustrate the organization graphically, using as guidance NMI 7120.4A.

b. Responsibilities.

Define management responsibilities of the PAA, IAA(s), SAA(s), the Program Director (if applicable), the Program Manager, and Project Manager(s), including the authority of these persons as described in NMI 7120.4. Indicate their responsibilities for developing, concurring, and approving principal program documents, such as the MNS, project-level requirements, the Program Plan, Project Plans, RFPs and other contract-related documents, reports associated with major reviews and other key activities.

5. PROGRAM RESOURCES.

Identify for each participating field installation yearly New Obligation Authority (NOA) estimates for system development and operations, facility construction, institutional support, and management. Civil service workforce levels should be included.

6. SCHEDULE.

Provide a schedule of program-level activities and events covering the system life cycle from Phase B through Phase E; include all applicable events, such as approval dates for entry into phases, approval dates for major program and projects documents, instrument selection dates, dates of major project reviews, launch date(s) (or equivalent system "delivery" date(s)), launch minus one-year and two-year (L-1 and L-2) MR's, and other Administrator or PAA decisions. Identify all headquarters-controlled milestones

7. CONTROLS.

Describe the process by which project-level requirements are validated for compliance with the program-level requirements. Describe the process for controlling changes.

Describe the process for updating the PCA as a result of any changes. Indicate key program parameters (cost, schedule, and technical) which will require Administrator, PAA, or HFI Program Manager approval for change.

Identify the Allowance for Program Adjustment (APA) and reserves management strategy and approval authority.

Project Plan

[Provide a title for the candidate program and designate a short title or proposed acronym in parenthesis if appropriate.]

Agreements:

Program Associate Administrator	Date
Program Director/HFI Program Manager or Field Installation Director	Date
Project Manager	Date

Title Page

PROJECT DEFINITION PLAN
or
PROJECT PLAN
or
PRELIMINARY/PROJECT PLAN

[TITLE]

FOREWORD

1. INTRODUCTION.

   1.1 Identification
   1.2 Background
   1.3 Summary

   The project is identified by an officially approved title, NASA Program, PCA, and/or Unique Project Number (UPN). A brief general history of the project is given. A brief summary is given, including the project's purpose, overall approach and timeframe. For multiple field installation projects, describe the field installation's project in relationship to the other participating field installations.

2. OBJECTIVES.

   State the specific project objectives and their relationship to the program objectives.

3. MANAGEMENT.

   3.1 Organization and Responsibilities
   3.2 Special Boards and Committees
   3.3 Management Support Systems

   Describe the project management structure including its integration into the program management structure, field installation participation. Identify all significant interfaces with other contributing organizations. Be consistent with the roles and responsibilities prescribed in NMI 7120.4. Identify specific management tools to support management in planning and controlling the project. Describe the use of special boards and committees.

4. RELATIONSHIP TO OTHER PROGRAMS.

   4.1 Related Activities and Studies
   4.2 Related Non-NASA Activities and Studies
   4.3 Internal NASA Agreements
   4.4 External Agreements

Other NASA, U.S. agencies and international activities, studies and agreements are summarized with emphasis on their effect on the program.

5. TECHNICAL SUMMARY.

5.1 Project-level Requirements
5.2 System(s)
5.3 System Operations Concept
5.4 System Constraints
5.5 Ground Systems and Support
5.6 Facilities
5.7 Logistics
5.8 Mission Results Analysis and Reporting

Project level requirements are presented along with a technical description of the project. This includes the allocation of these requirements among the systems to be developed (hardware and software), use of the metric system, facilities, flight plans, operations and logisitcs concepts, and planned mission results analysis and reporting.

6. TASK DESCRIPTIONS.

6.1 Implementation Approach
6.2 Project Summary Work Breakdown Structure

The implementation mode of the project is described (e.g., in-house, field installation prime, contractor prime). A project-level work breakdown structure (WBS) shall be provided.

7. PROCUREMENT SUMMARY

Provide summary information on procurement items, such as: element (engineering design study, hardware development, mission and data operations support, etc.); type of procurement (competitive, Announcement of Opportunity for instruments, etc.); type of contract (cost reimbursable, fixed price, etc.); source (institutional, contractor, other government organizations, etc.); procuring activity (NASA installation); and technical monitoring (NASA installation).

8. SCHEDULES.

Present the project master schedule for all major events and activities planned for the entire project throughout all remaining phases of the program. Include approval dates for principal program/project documentation, life cycle transitions, major reviews, Headquarters controlled milestones, and significant contract milestones. Identify lower level schedules to be developed and maintained.

9. RESOURCES.

9.1 Funding Requirements

Present a funding requirements chart that includes the same elements as for the procurement summary (see Section 7). Show the NOA in real year dollars for the prior, current and remaining fiscal years. The level of detail should be at WBS 2.0 level or its equivalent.

9.2 Institutional Requirements

Present the institutional requirements for the entire project throughout its life cycle. Include Civil Service workforce requirements on the providing organizations for the prior (actuals), current, and remaining years.

10. MANAGEMENT REVIEWS.

10.1 Program-Level Reviews
10.2 Project-Level Reviews

Provide the names, purposes, content and timing of all reviews shown in the Schedules section. Explain the reporting requirements for each.

11. CONTROLS

11.1 Administrator
11.2 Program Associate Administrator

All technical performance, cost, or schedule parameters specified as requiring approval to change by the Administrator, the PAA or HFI Program Manager (if applicable) should be identified. (Examples include funding by year, program-level requirements, project objectives, program and project management structure, and major program/project documentation.) Identify the thresholds associated which each parameter which could cause a CR.

Describe the process by which project-level requirements are validated for compliance with program-level requirements. Describe the process for controlling changes to these requirements.

12. PERFORMANCE ASSURANCE*.

12.1 General
12.2 Reliability
12.3 Quality Assurance
12.4 Parts
12.5 Materials and Processes Control
12.6 Performance Verification
12.7 Contamination Allowance and Control

12.8 Software Assurance
12.9 Maintainability

For each of the subsections, cite the relevant requirements documents and summarize how they will be followed. The plans and specific procedures should be identified to accomplish the applicable performance assurance items listed in the subsections.

13. RISK ASSESSMENT*.

All major programmatic and technical risks should be identified along with the planned approach to reduce the risks to acceptable levels. Refer to Chapter 6 of this Instruction for guidance on risk management planning.

14. ENVIRONMENTAL IMPACT*.

The required environmental impact assessment/statements for the project should be identified along with the schedule for their accomplishment

15. SAFETY*.

13.1 Industrial Safety
13.2 Range Safety
13.3 System Safety

For each of the subsections, cite the relevant safety requirements documents and summarize how they will be followed.

16. SECURITY*.

Cite the relevant institutional and NASA security requirements documents and summarize how they will be followed.

* Project Definition Plan requires only a description of the general approach.

CHAPTER 2

APPENDIX B: DESIGN REVIEWS

PRELIMINARY DESIGN REVIEW

1. PURPOSE.

The PDR is held at the system, subsystem and component level to demonstrate preliminary designs meet system requirements with acceptable risk. All interfaces and verification methodologies must be identified.

Successful completion of the PDR will result in approval of configuration item specifications, release of the preliminary design drawings, and serve as prerequisite to proceeding with detailed design.

2. OBJECTIVES.

The objectives of the PDR are to assure that:

(a) All system requirements have been allocated to the subsystem and component level and the flow down is adequate to verify system performance.

(b) The design solution being proposed is expected to meet the performance and functional requirements at the configuration item level.

(c) There is enough evidence in the proposed design approach to proceed further with the next step of detailed design phase.

(d) The design is verifiable and does not pose major problems which may cause schedule delays and cost overruns.

3. CRITERIA FOR SUCCESSFUL COMPLETION.

(a) There is evidence that the preliminary design will meet performance, cost, and schedule as planned.

(b) Overall system architecture has been established and all the external interfaces have been identified.

(c) All system, subsystem and component specifications are complete and ready for formal approval.

(d) The proposed design does not violate any safety requirements which will endanger human life or mission success.

(e) The reliability analysis is based on a sound methodology and presents realistic predictions for logistics planning and life-cycle cost analysis.

(f) The design solution is producible based on existing processes and techniques; if not, risk areas which require unique and unproven processes are identified and plans established.

(g) There are no or minimum number of long lead items which may threaten schedule compliance.

(h) Required resources (workforce and facilities) are available to proceed further.

(i) An acceptable operations concept has been developed.

CHAPTER 2

APPENDIX B: DESIGN REVIEWS

CRITICAL DESIGN REVIEW

1. PURPOSE.

The CDR is held after completion of design development activities i.e., completion of detailed design phase. All technical problems and design anomalies must be resolved without compromising system performance, reliability and safety.

Successful completion of the CDR will result in the release of approved drawings for fabrication, approval of manufacturing plan, test plan and procedures, and permission to proceed with the software coding and system qualification testing and integration.

2. OBJECTIVES.

The objectives of the CDR are to assure that:

(a) The detailed design will meet performance and functional requirements.

(b) All recommendations from design audits by specialty engineering groups, manufacturing, safety, quality, operations and utilization and test organizations have been answered and all action items are closed.

(c) The design can be smoothly transitioned into the manufacturing phase.

(d) The program is ready to commit to setting up tooling, facilities and manpower to fabricate, integrate and test based on this design baseline.

3. CRITERIA FOR SUCCESSFUL COMPLETION.

(a) There is substantial evidence that the detailed design will meet performance, cost and schedule as planned.

(b) Fabrication drawings have been completed with a complete inventory of bill of materials including any long lead items.

(c) Software simulations and prototyping results do not present any potential risks which may hamper software coding and integration.

(d) All engineering analyses such as thermal, power distribution, and stability are complete, accurate and the detailed design is based on these results.

(e) Integrated safety analysis shows that there are no outstanding hazards which cannot be controlled or are within an acceptable risk level if waivers are required.

(f) The integrated logistics analysis shows complete spares provisioning for the life of a program.

(g) A comprehensive system verification approach (that minimizes on-orbit checkout risks for flight systems) has been established.

CHAPTER 3

KEY PERSONNEL

1. PURPOSE

An important factor in determining a program/projects' readiness to move from one phase to the next phase will be the qualifications of the key personnel. These policies and procedures specify the human resources policies and procedures that must be followed to ensure that NASA has highly qualified people in all key PPM positions.

2. POLICIES

a. Key Personnel Selection. Key PPM personnel will meet the qualification criteria for assignment to a program or project. The decision criteria on the selection of key personnel will encompass previous assignments and their accomplishments in getting the program objectives accomplished within budget and on schedule. Other criteria that will be evaluated is training, education and development opportunities they have experienced.

b. Key Personnel Qualifications. The qualifications of key PPM personnel shall include:

(1) Demonstrated technical expertise, including hardware and software development experience, is mandatory.

(2) System integration skills which include engineering and analysis, testing, and systems interface management. A working knowledge of the project life cycle, work breakdown structure, risk management, control gates, and system analysis and modeling.

(3) Planning skills which include a working knowledge of project planning tools and their use in project implementation and strategic planning including the establishment of contingencies for time, funding and other resources.

(4) Business management skills such as competence in program control and specific knowledge of program planning and scheduling, cost estimating, budgeting and performance measurement. An understanding of institutional requirements and the system acquisition approach (e.g. contract management, procurement, source evaluation boards).

(5) Human resource management skills in one-on-one and group settings. This includes the ability to develop employees, performance management, delegation skills, managing conflict, establishing collaborative and open work environments.

(6) Communication skills including both written and oral skills. This includes the ability to prepare clear, precise documents (e.g. statements of work, plans, specifications) and the ability to provide timely feedback to individuals (both positive and critical). The ability to communicate openly and honestly the overall goals, roles, and current events of a project is a key requirement.

(7) Teamwork skills including the ability to work across organizational lines effectively and cooperatively. (The team includes members of centers, headquarters, top management, peers, procurement, contractors, and members of external organizations.)

c. Training and Development. The agency will implement a systematic training and development program as required for supplying the agency with an adequate number of well qualified candidates to fill project management positions. Training and development programs will be structured around proven characteristics of effective program and project managers based upon NASA research and other studies and shall be consistent with the following guidelines:

(1) New members of the project workforce shall be provided with an understanding of what it takes to progress to the next step in their careers. Individual Development Plans (IDPs) will be used to focus individual efforts and communicate anticipated individual developmental requirements.

(2) Agency management will require a continuum of development activities for project managers from new hire to senior executive level. Work experience, developmental assignments, and a training curriculum will be provided to enable the continuous improvement of project managers.

(3) While formal education is not a requirement for project management success, an advanced degree will be encouraged by senior managers.

(4) Developmental assignments, and rotations to other organizations, will be encouraged. Rotational assignments should include the technical needs of the individual as well as exposure to business management principles.

d. Executive Responsibilities. The PMC will provide the overall direction for the establishment and maintenance of the program/project manager qualifications and for the corresponding NASA development program to assure NASA personnel meet these qualifications. The Program/Project Management Steering Group (PPMSG) will support the PMC in this function by providing oversight of the PPM Training and Development Program.

3. PROCESSES

a. Development Processes. Headquarters and field installations will establish processes that assure personnel have the opportunity to move through a progressively increasing set of responsibilities for achieving project objectives, within budget and on schedule, and attend training and development opportunities that deal with the full spectrum of program management activities. Program/project personnel performance plans will identify individual development activities as a Key Specific Objective.

b. Independent Assessment of Key Personnel Qualifications. The NAR Team will assess the qualifications of key project personnel using the following criteria:

(1) Do key project personnel possess demonstrated experience in managing a project?

(2) Do team members have strong technical knowledge pertaining to the area of work?

(3) Do the key personnel have experience in resource management?

(4) Is the combination of formal education and experience of key personnel adequate?

(5) What specific training and development in project management (specifically in system integration, planning, business management, managing people, organization/analytical skills, communication, and teamwork) does the project team have?

CHAPTER 4

ACQUISITION MANAGEMENT

References:
(a) Federal Acquisition Regulation (FAR)
(b) NASA Federal Acquisition Regulation Supplement (NFS)
(c) Title 41, United States Code, Section 418, "Advocates for Competition"
(d) Title 10, United States Code, Section 2318, "Advocates for Competition"
(e) NMI 5900.1, "NASA Spare Parts Acquisition Policy"
(f) OMB Circular A-109, "Major Systems Acquisitions"
(g) NHB 5600.2, "Statements of Work"
(h) NHB 5103.6, "Source Evaluation Board Handbook"
(i) NASA Publication, "Guidance for the Establishment and Conduct of Acquisition Strategy Meetings"

1. PURPOSE

These policies and processes establish the basis for acquisition management.

2. POLICIES

a. As set forth in OMB Circular A-109, the head of each agency that acquires major systems will designate an acquisition executive to integrate and unify the management process for the agency's major system acquisitions and to monitor implementation of the policies and practices set forth in that Circular. At NASA, the Deputy Administrator serves as the agency acquisition executive.

b. A primary goal in developing the acquisition management approach shall be to minimize the time and cost of satisfying an identified, validated need consistent with common sense, sound business practices and the basic policies of this instruction.

c. The acquisition management approach shall evolve through an iterative process and become increasingly more definitive in describing the relationships of the essential elements of a program. Essential elements in this context refer to the management, technical, resource, procurement and contracting, development, testing, training, operations, support and other aspects critical to the success of the program. The acquisition management approach should also evaluate the need and

the acquisition strategy for dual sources for the hardware, software, consumable and expendable items to support operation throughout the life of the system.

d. The acquisition management approach and planning should begin as soon as NASA's need is identified - at the decision to proceed with Phase A - and should integrate the efforts of all functions responsible for significant aspects of the acquisition.

e. The acquisition management approach shall be tailored to meet the specific needs of individual programs consistent with the policies established in the documents referenced above.

f. The acquisition strategy shall:

(1) Define the mix of system, data, and/or service acquisitions that best meet a program/project's cost and other requirements; and

(2) Promote cost containment through innovative contracting methods which significantly motivate the contractor to meet cost baselines as negotiated.

3. PROCESSES

a. Initial and Subsequent Acquisition Approaches.

(1) An initial acquisition approach for the proposed concept(s) will be developed and approved or modified as a result of a decision to proceed with Phase A by the responsible PAA.

(2) The approach should be subsequently developed in sufficient detail to establish the combined business, technical and managerial approaches which will be used to direct and control all elements of the acquisition to achieve program objectives. It should include a clear description of risk elements, including cost, technical, programmatic, supportability, performance, and schedule, and the corresponding strategies to abate those risks. (See Chapter 6).

(3) The acquisition management approach will be kept current and formally updated at each major program decision gate as the system approach and program elements are better defined.

b. Event Driven Acquisition Management and Event Based Contracting.

(1) The objectives of event driven acquisition management and event based contracting are to:

(a) Highlight key developmental events;

(b) Avoid premature commitment to programs;

(c) Avoid forcing program/project decisions solely because of potential loss of priced contract options that may expire on certain dates; and

(d) Hold the contractor accountable for the cost of delays caused by events within the contractor's control.

(2) Event driven acquisition management explicitly links program decisions to demonstrated accomplishments in development, testing and initial operations.

(3) Event based contracting supports event driven acquisition management by imposing the linkages between demonstrated performance and corresponding program phases. The events set forth in contracts must support the appropriate exit criteria for the phase or intermediate development events established for acquisition management.

c. Competitive Environment. The acquisition management approach for a program will describe plans to develop and maintain a competitive environment throughout the course of the acquisition.

(1) Competition at the prime and subcontract level must be considered during each acquisition phase. The management approaches for acquisition must be developed considering the provisions of existing statutes and regulations.

(2) The competition advocate designated by the head of each field installation or component with acquisition responsibilities will be responsible for:

(a) Assuring that planning for competition is accomplished in each acquisition phase, to minimize inhibiting factors and to enable consideration of reasonable competitive alternatives to proposed noncompetitive actions;

(b) Challenging barriers to promoting full and open competition, including unnecessarily

detailed specifications and unnecessarily restrictive statements of work; and

(c) Otherwise complying with the requirements of references (c) and (d) above.

d. Tailoring and Concurrency. The acquisition management approach will be tailored to match the character of the program and allow the most efficient satisfaction of individual program requirements, consistent with the degree of risk involved.

(1) Commensurate with risk and affordability considerations, such approaches as maintaining multiple alternatives in high risk areas, competitive prototyping of critical systems, subsystems and components, combining developmental and operational test and evaluation, dual sourcing, and using multi-year procurement should be considered.

(2) The benefits and risks associated with reducing lead time through concurrency will be specifically addressed in tailoring the acquisition management approach.

(a) Typically there will be overlapping of activities associated with the phases of an acquisition program. Such overlapping of phases is known as concurrency.

(b) The most common form of concurrency is the production of a system while developmental activities are still ongoing. The risk in such concurrency is that of producing hardware or software that might later prove to be unsuitable and must then be discarded, modified to be useful, or upgraded to a later configuration.

(c) The project manager must balance the risks of concurrency with the costs of alternative approaches. The risks inherent in the degree of concurrency chosen for the program will be addressed at the PPAR's (Phase B and Phase C/D).

e. Management Requirements on Contractors. In tailoring an acquisition management approach, the project manager must also address the management requirements imposed on the contractor(s). Process-related requirements that are not mandated by statute will be critically examined to determine the necessity of use during the formulation

of an acquisition management approach.

f. Phased Project Planning. The acquisition management approach must be coordinated with and linked to the control gates in the entire NASA project life cycle - Phase A through Phase E (See Chapter 2).

(1) NASA's major systems are normally acquired through the use of a multi-phased acquisition strategy which supports the entire life cycle of the project. Therefore, the acquisition strategy must be fully integrated with the program and project plans during the planning stages, i.e., prior to completion of Phase A. As these plans go through their iterative processes, and are updated prior to passing through the main decision gates, the acquisition strategy and planning also must be updated.

(2) There are several approaches to accomplishing these multi-phase major system acquisitions ranging from separate acquisition of each phase to competitive down-selection of combined phases. The preferred technique in NASA is use of a competitive down-selection strategy, and the preferred variation of this strategy is the "progressive competition" approach. The acquisition plan should carefully address and document the rationale for the selected approach.

(3) In a progressive competitive down-selection, a single formal solicitation is issued prior to Phase B for that phase and all subsequent phases. Multiple contracts are awarded for the initial phase, and a competitive down-selection from among these contractors is conducted to determine the succeeding phase contractors. Progressive competition procedures, when properly planned and executed, facilitate the realization of the desirable goals of effective and efficient acquisition of major systems, preservation of full and open competition throughout the entire process, and acquisition streamlining.

(4) Even with these streamlined approaches, Source Evaluation Board (SEB) procedures must be used, and advance leadtime plans are essential to ensure that the entire procurement process is integrated into the acquisition strategy. Concurrent with these considerations in acquisition strategy, a careful look at each step of the process is critical to reduce all unnecessary downtime between phases, and to run tasks concurrently, where appropriate.

Specific reference material is provided below:

FAR Part 7	Acquisition Planning
FAR Part 34	Major System Acquisition
NFS Part 18-7	Acquisition Planning
NFS Part 18-34	Major System Acquisition
NFS Part 18-70	Source Evaluation Board

g. Lead-time. Advance and continuous planning is critical to the success of any project. Early involvement of all team players is equally important. In this regard, early involvement of the contracting officer, even prior to Phase A, is strongly advised. Depending on key program features, the contracting officer can provide advice regarding critical lead-times that must be planned. Typically, the solicitation will be on the street for 60 calendar days; the SEB process is targeted for 120 days. However, time must also be planned for such parallel activities as issuing a source sought synopsis and evaluating the resultant contractor qualification statements; drafting the procurement plan; conducting acquisition strategy meetings (ASM's); establishing the proposal evaluation criteria; selecting the contract type(s) most appropriate given program risk; drafting the solicitation document. These are only a few of the many activities that must be successfully accomplished - prior to issuance of the RFP's. These activities are not included within the six months lead-time for issuance of the solicitation and subsequent SEB activities. The team must work together to chart all activities involved for a successful procurement, including those activities that can run concurrently. However, for concurrent activity to be effective, it must be planned in advance for each individual project.

h. Procurement Plan. Every acquisition shall be adequately planned to allow enough time to complete the competitive procurement process and award a contract or contracts by the required date. The FAR and the NFS should be consulted for specific requirements of individual procurement plans, but generally included are the following elements:

(1) A description of the procurement(s), including options and later phases contemplated for the same project (Phases A through E);

(2) The number of units, delivery schedule, and/or period of performance;

(3) Identification of option provisions, what they must contain, and the impact to total contract duration;

(4) A statement addressing whether the contractor(s) will be required to comply with detailed specifications, meet performance requirements, or furnish a level of effort;

(5) Identification of responsible parties, i.e., name of installation and responsible individual; in the case of major systems acquisitions, the major stakeholders shall be named;

(6) Total estimated cost of the procurement, including options; in the case of major systems, include the total estimated cost for each phase and link the instant procurement(s) to a specific phase (i.e., Phase A - Preliminary Analysis, Phase B - Definition, etc.);

(7) Proposed funding by fiscal year and UPN;

(8) A description of how competition will be sought, promoted and sustained throughout the course of the acquisition;

(9) Recommended type of contract(s) and, where appropriate, contemplated profit/fee arrangements;

(10) Coverage of contractor-owned and Government furnished property involved;

(11) A cost containment plan with goal, list of positive and negative incentives, and overall cost containment strategy to assure minimal growth;

(12) Contract management considerations: The procurement plan shall address the basic plan for post-award management of the pending contract(s). At a minimum, it shall address planned delegations of contract administration functions to DoD contract administration service components, delegation of any duties to a Contracting Officer's Technical Representative, anticipated subcontracting activity, quality assurance requirements, oversight of Government property, and the contractors' property system, site access and site preparation, and the need for any unique contract management activity;

(13) Depending on the complexity of the procurement, other areas should also be considered for coverage in the procurement plan, including test and evaluation requirements and programs, logistics/support considerations, Government furnished information, environmental considerations, security considerations, and the

milestones for the acquisition cycle;

(14) Specific procurement milestones also should be addressed, including the following:

(a) Procurement Plan approval,

(b) Statement of Work approval,

(c) Specification(s) approval,

(d) Data requirements approval,

(e) Completion of acquisition package preparation,

(f) Purchase request approval,

(g) Completion and approval of various justifications required by statute,

(h) Issuance of synopsis,

(i) Establishment of proposal evaluation criteria,

(j) Issuance of solicitation,

(k) Establishment of SEB,

(l) Completion of proposal evaluation, audits and field reports,

(m) Completion of SEB process,

(n) Beginning and completion of negotiations,

(o) Contract preparations, review and approval,

(p) Contract award,

(q) Post-award contract management, and

(r) Contract completion

i. Acquisition Strategy Meeting (ASM). The ASM is a meeting where interested parties resolve major issues and agree on the acquisition strategy. An ASM provides a forum where technical, financial and procurement personnel perform as a team to discuss the key issues of a major procurement. The establishment of a Headquarters/field installation team will engender the continuation of successful cooperative endeavors, and, at the same time, focus greater attention on the planning and management of NASA's acquisitions. It also will provide an opportunity for all parties to gain a

clear understanding of the requirement and proposed business approach; this understanding should simplify required reviews and approvals, thereby reducing procurement lead-time. The ASM provides an opportunity for key program participants to review the logic and discipline of the planning process.

When an ASM is conducted, formal written minutes are prepared to summarize the decisions, actions, and conclusions of the ASM participants. These approved minutes serve as the formal procurement plan required by NFS 18-7.103(a). ASMs may be held at NASA Headquarters or field installations. The following offices will normally participate:

(1) Headquarters: cognizant program office, procurement, comptroller, safety and mission assurance and the general counsel.

(2) Installation: project office, procurement, and other offices as determined appropriate.

(3) Major stakeholders shall always attend.

j. Post-award Contract Management. Throughout the life of the contract(s), effective post-award contract management is critical. Typically, post-award contract management will involve all aspects of the program where the contractor has performance requirements leading to delivery of a design, a component or a system. Some of these performance requirements include system engineering and project management, configuration management and control, logistics support, subcontract management, risk management, data management, and cost control. Fees paid to contractors need to be consistent with contract performance in accordance with NASA procurement policy regarding payment of fees.

(1) NASA will use Contractor Metrics, a system for reporting a contractor's in-process performance from the NASA project manager through the PAA to the Administrator and for reporting the Government's assessment of that performance back to the contractor. The metrics include cost, schedule, technical, award fee, subcontracting plan, project manager's assessment and continual improvement.

(2) Technical requirements should be clearly and completely defined in each change direction. Undefinitized contractual actions are to be issued on a strict exception basis. NASA's preferred method for handling such actions is to use a team approach, whereby technical, procurement, resource

and contractor personnel concurrently review a proposed change prior to any contractual action.

(3) Every effort should be made to keep the contract baseline consistent with the project baseline. Effective post-award contract management, involving the program stakeholders, is essential to ensuring program success.

CHAPTER 5

PROGRAM/PROJECT PLANNING AND CONTROL

Program/project planning and control is an integral part of program and project management. It defines the interrelationships of the various elements that comprise a program/project, and serves as a process that ties each element to the other. The inter-relationships provide a framework for the program/project manager to assess, control and track progress through the life cycle of a program/project.

Program/project planning and control establishes a series of schedule, technical and resources baselines, which chart the course of the program/project and are used to measure deviations. Planning and control create the program/project management strategy and architecture by defining program organization, roles and responsibilities, forums, processes and products keyed to a WBS for the program.

Program/project planning and control balances cost, schedule and technical performance commitments through a continuous process of data collection, risk assessment, alternatives development, and program analysis for the program/project manager to make informed decisions. Each of the functional specialties contributes to this decision process that manages the risk through judicious application of reserves to mitigate the risks.

This chapter establishes the policies and processes that apply to major system development programs and their relationships to the other elements of the program.

SECTION	SUBJECT
A	Affordability
B	Life-Cycle Cost Management
C	Systems Engineering
D	Work Breakdown Structure
E	Schedule Management
F	Cost Estimating
G	Resource Management
H	Configuration Management
I	Technical Data Management
J	Performance Assessment

CHAPTER 5

REFERENCES

References:

(a) OMB Circular A-94, "Guidelines and Discount Rates for Cost-Benefit Analysis of Federal Programs"
(b) OMB Circular A-11, "Preparation and Submission of Budget Estimates"
(c) NHB 7400.1 "Budget Administration Manual"
(d) NMI 9050.3, "Administrative Control of Appropriations and Funds"
(e) NMI 9501.1, "NASA Contractor Financial Reporting Systems"
(f) NHB 9501.2, "Procedures for Contractor Reporting of Correlated Cost and Performance Data"
(g) MIL-STD-490, "Specification Practices"
(h) MIL-STD-973, "Configuration Management"
(i) DoD-STD-2167, "Defense Systems Software Development"
(j) DoD-STD-2168, "Defense System Software Quality Plan"
(k) DoD 5010.12, "Acquisition Management Systems and Data Requirements Control List"
(l) MIL-STD-1806, "Marking Technical Data Prepared by or for the Department of Defense"
(m) NMI 2340.3, "Implementation of Contractor Metrics"
(n) NHB 2340.4, "Contractor Metrics"
(o) GAO Report B-237602, "Project StatusReports"
(p) NMI 1240.3, "Functional Management"

CHAPTER 5

SECTION A

AFFORDABILITY

1. PURPOSE

Affordability constraints and assessments assure program life-cycle resource requirements are consistent with Agency strategic planning and realistic projections of budget availability.

2. POLICIES

a. Individual plans for new major system programs must be consistent with realistic projections of budget availability and with overall NASA planning and funding priorities as derived from the long-range strategic planning of the Agency.

b. Affordability constraints (budget, workforce and institutional support) shall be established for the life cycle of each project at the completion of Phase A.

c. Affordability shall be reassessed at each project phase decision point beginning with the completion of Phase A.

d. A project shall not be approved to enter the next life cycle phase unless sufficient resources, including workforce, are or will be programmed to support projected development, testing, production, launch and operations requirements.

e. Program planning shall be structured to assure viability at alternate levels of funding consistent with the priority of programs/projects.

f. Performance parameters and key requirements necessary to assure continuing affordability throughout all phases of the project life cycle shall be specified in the PCA, and control/measurement systems shall be implemented during Phase C/D to assure their achievement.

3. PROCESSES

a. Program /Project Cost Estimating. In order to enable the affordability assessments to be made at the Agency level, program/projects must develop and implement an effective cost estimating capability for life cycle costs (LCC). (See Figure 5-A-1)

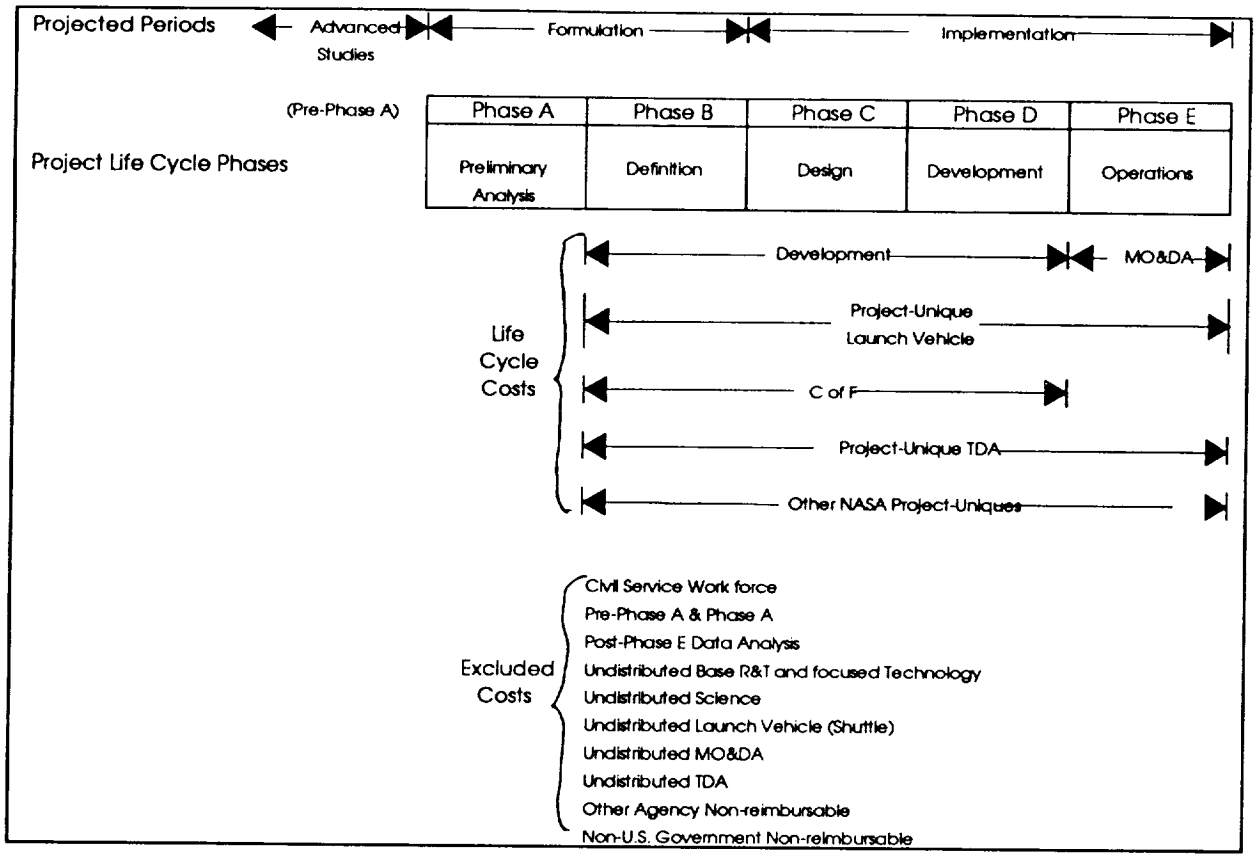

Figure 5-A-1. Program/Project Costs

(1) Program/project life-cycle cost assessments must show annual resource requirements.

(2) Civil service and institutional support requirements must be considered.

(3) Program/project life-cycle cost assessments must include any required resource demands from other NASA programs.

b. The PAA is required to explicitly address affordability at the PPAR. The analysis shall:

- Identify cost and benefits of alternate levels of requirements and capability for the proposed alternative;

- Identify how program structure, schedule planning and acquisition strategy support milestones of a viable program at reduced levels of funding availability;

- Address the relative priority of this program/project to ongoing programmatic and

institutional activities; and

- Address the sources of the required resources (tradeoffs within the mission area or Agency, commitment of new resources or other sources).

c. Agency Affordability Constraints. The PMC shall use affordability as a key evaluation criteria in recommending initiation and continuation of development programs.

d. Program/Project Management Within Constraints. Performance parameters and key cost assumptions necessary to assure continuing affordability in later phases of the life cycle should be specified in the program/project commitment and control system, and should be established and implemented throughout the development phase to assure their achievement.

CHAPTER 5

SECTION B

LIFE-CYCLE COST MANAGEMENT

1. PURPOSE

Life-cycle cost management, which transcends traditional design-to-cost objectives, is used to predict, assess, review, negotiate, monitor and control development and other life cycle costs for a project. This enables the program and project managers to ensure that appropriate trades are made among total costs, acquisition costs, ownership costs, schedules, risk and performance.

2. POLICIES

a. Life cycle cost shall be estimated, assessed and controlled throughout each project life cycle.

b. The PAA will identify a common set of groundrules and assumptions for specification and estimation of LCC and its components. The PAA will ensure that groundrules, assumptions and methods used by the CFO/Comptroller to determine the differences between the Estimate at Completion (EAC) and the PCC are available to the program and project managers.

c. Life-cycle cost considerations shall be integrated into the design and development process including the formal change control process.

3. PROCESSES

Life-cycle costing shall be integrated into Program/Project Formulation to project and assess the LCC of alternative implementations. This critical capability must be maintained and exercised during trade studies and formal change control assessments carried out as a part of any LCC management program during Project Implementation.

a. Use of this capability early in the project cycle (Phases A and B) during requirements analysis and system-level trades should focus on the LCC effects of varying mission design/mission effectiveness parameters. Such high-level trade studies help identify whether a slight relaxation of performance requirements could result in a significantly cheaper system or whether a small increase in LCC resources could produce a significantly more effective one.

b. Use of this capability during Project Implementation

should focus on assuring the LCC effects of refinements in the system design, operations concept, and/or associated downstream processes (such as fabrication, verification, operations and support, and disposal) are consistent with the PCC and the DCC component of the PCC.

c. For major changes in system design, operations concept, and/or associated downstream processes, LCC effects must be projected and submitted as a part of any formal change control request.

d. Projecting the LCC effects of a change in system design, operations concept, and/or associated downstream processes requires the involvement of a variety of technical and engineering specialty disciplines. The program and project managers must make LCC management an indistinguishable part of the PPM effort.

CHAPTER 5

SECTION C

SYSTEMS ENGINEERING

1. PURPOSE

These policies and processes establish the basis for integrating the technical efforts of the entire project (system) design team to meet cost, schedule and performance objectives. These efforts are meant to create a satisfactory design solution that encompasses the system and its associated fabrication, verification, operations and support, and disposal processes.

2. POLICIES

a. Systems engineering, including the processes sometimes called "project engineering", shall be applied throughout the program/project life cycle as a comprehensive, iterative technical and management process to:

(1) Translate an operational need into a system meeting that need within acceptable cost, schedule and risk parameters through a systematic, concurrent approach to integrated design of the system and its related downstream processes--fabrication, verification, operations and support, and disposal.

(2) Integrate the technical input of the entire development community and all technical disciplines, (including engineering specialty disciplines such as reliability and logistics) into a coordinated effort that meets all established cost, schedule and performance objectives, with acceptable risk.

(3) Ensure the compatibility of all functional and physical interfaces (internal and external), and ensure that the system definition and design reflect the requirements for all system elements--hardware, software, facilities, personnel and data.

(4) Identify and characterize program/project risks and develop risk mitigation approaches as appropriate to the level of risk selected for the project/system.

(5) Provide information, such as trade studies and project (system) status assessments, to support management decision making.

b. The primary roles of the NASA and contractor project offices in the systems engineering process shall be management and execution of systems engineering, respectively.

3. PROCESSES

a. The project office will work with the user or user's representative to establish the feasibility of operational requirements and identify the critical operational characteristics and constraints (see Chapter 10).

b. A disciplined user requirements collection and system design methodology will be used to convert and refine these requirements into detailed design specifications. This methodology should provide traceability of design products and operational products to user requirements. This methodology shall include verification of the adequacy of designs and operational processes with respect to meeting requirements.

c. A rigorous process will be established to balance design specifications so as to optimize the system design. This process will provide for concurrent engineering among members of the design team to ensure that all necessary engineering design elements and downstream processes (such as fabrication, verification, operations and support, and disposal) present their design issues in a timely manner. Cost management objectives shall be considered as a design parameter in this process.

CHAPTER 5

SECTION D

WORK BREAKDOWN STRUCTURE

1. PURPOSE

These WBS policies and processes establish the essential framework for project: technical planning, scheduling, cost estimation and budgeting; defining the scope of statements of work and contracts; developing documentation products (including specifications and drawings); and program/project status reporting and assessment (including integrated cost/schedule performance measurement).

2. POLICIES

a. The WBS shall:

(1) Define all the work necessary to complete the project;

(2) Be a product-oriented, hierarchical division (tree) of deliverable items (hardware, software, information) and associated services; and

(3) Relate the elements of work to each other and to the end item (system or product).

b. A WBS shall be developed for each project and for each individual contract.

(1) A preliminary project WBS will be developed in Phase A to define the top levels of a WBS for the entire project (system) life cycle. Normally, this life cycle WBS will be in two parts--one for the acquisition cycle of the system being acquired (Phases A through D), and one for the operations and support phase (Phase E).

(2) A final project WBS will be prepared by compiling the elements of the contract WBS(s) with the preliminary project WBS.

3. PROCESSES

a. Project WBS. The project WBS should contain the project's Product Breakdown Structure (PBS), with the specified prime product(s) at the top, and the systems, segments, subsystems, etc. at successive lower levels. At the lowest level are products such as hardware items, software items and information items (e.g., documents,

databases, etc.) for which there is a cognizant engineer or manager.

(1) Branch points in the hierarchy should show how the PBS elements are to be integrated. The WBS is built from the PBS by adding, at each branch point of the PBS, any necessary service elements, such as management, systems engineering, integration and verification, and integrated logistics support.

(a) The family of specifications and drawings resulting from the progressive steps of systems engineering will conform to the WBS.

(b) Integrated logistics support will be accommodated in the appropriate WBS elements.

(c) Software will be accommodated in the appropriate WBS elements. Software will be identified with the hardware it supports. Any aggregations of WBS elements required for software management and reporting will be accomplished by summation of relatable elements of the project WBS.

(d) Overall system software to facilitate the operation and maintenance of the computer systems and associated programs (e.g., operating systems, compilers, and utilities) and applications software that interfaces with more than one equipment item will be called out at the appropriate WBS level.

(e) If several WBS elements require similar equipment or software, then a higher level WBS element can be defined to perform a block buy or a development activity (e.g., "System Support Equipment").

(2) A project WBS will be carried down to the level appropriate to the risks to be managed. The appropriate level of detail is determined by management's desire to have visibility into costs, balanced against the cost of planning and reporting.

(3) Extensions of the WBS will be consistent with a product-oriented approach, but can be tailored to the specific project.

b. Contract WBS.

(1) Contractors must have a Contract WBS (CWBS), which is appropriate to the contractor's needs to control

costs. A summary CWBS, consisting of the upper levels of the full CWBS, is usually included in the project WBS to report costs to the project office.

(2) From the initial project WBS, preliminary CWBS(s) for individual contracts will be negotiated with the contractors involved. The CWBS will be extended to lower levels by the contractor in accordance with the product-oriented approach.

c. WBS Identification. WBS elements must be identified by title and by a numbering system that performs the following functions:

(1) Identifies the level of the WBS element;

(2) Identifies the higher level element into which the WBS element will be integrated;

(3) Shows the cost account number (if any) of the element.

d. WBS Dictionary. A WBS must have a companion WBS dictionary that contains each element's title, identification number, objective, description, and any dependencies (e.g., receivables) on other WBS elements. This dictionary provides a structured project description for orienting both project staff and others. It fully describes the products and/or services expected from each WBS element, and should be consistent with any contractor statement of work.

CHAPTER 5

SECTION E

SCHEDULE MANAGEMENT

1. PURPOSE

Schedules establish interrelationships and time-phasing of activities and events essential for the timely and effective implementation of a program/project. The goal of scheduling is to provide a framework to time-phase and coordinate activities into a master plan in order to complete the program/project within the established constraints and balanced cost, schedule and performance commitments.

The Schedule Management (SM) function establishes, monitors and maintains the baseline master schedule and derivative detailed schedules. It establishes and operates the scheduling system and defines the schedule format, content and symbology, and control processes. A critical component of the SM function is the selection, in response to the program logic, of key progress milestones and indices for measuring performance and indicating problems.

2. POLICIES

a. The Integrated Program Master Schedule (IPMS) will identify all milestones controlled by the PAA. Major development programs will establish commitment milestones between the PAA and the Administrator. The IPMS will be derived from the MNS.

b. IPMSs will consist of at least one controlled milestone per fiscal year.

c. Program/project schedules will conform to the program/project WBS.

d. Program and project schedules will be used as a controlled baseline for regular status reporting.

3. PROCESSES

a. A preliminary IPMS will be developed as part of Phase A.

b. The program/project schedule will be developed based on the program/project WBS.

c. A critical path will be established and maintained for all programs/projects.

d. Phase C/D contractor schedules will be reported at sufficient detail that visibility is maintained at least to the level of the critical path, with full cost, schedule and technical reporting made on critical path elements. This schedule reporting will be consistent with established procedures including:

(1) Use of standard symbology.

(2) Use of automated tools is highly encouraged.

e. To the extent possible, program schedules should flow from the system being used by the contractor.

f. Program schedules for programs subject to PCAs will be reviewed:

(1) Quarterly by the PMC,

(2) Annually by an IAR team, and

(3) As required in support of NAR's, PPAR's, CR's, and MR's.

CHAPTER 5

SECTION F

COST ESTIMATING

1. PURPOSE

These policies and processes establish the basis for the production and review of cost estimates in support of NASA programs.

2. POLICIES

a. Life-cycle cost estimates shall be prepared in support of:

(1) The program commitment process; and

(2) Major reviews including NAR's, PPAR's, IAR's, CR's, and MR's at L-2 and L-1.

b. Cost estimates prepared in support of the above shall be:

(1) Explicitly based on the program objectives, operational requirements and contract specifications for the system, including plans for matters such as launch vehicles, unique facilities and project unique support costs;

(2) Comprehensive in character, identifying all elements of additional cost that would be entailed by a decision to proceed with development, production and operation of the system;

(3) Neither optimistic nor pessimistic, but based on a careful assessment of risks and reflecting a realistic appraisal of the level of cost most likely to be realized;

(4) Correlated to a well-defined technical baseline and a detailed schedule; and

(5) Inclusive of estimated savings, if any, resulting from private-sector or international participation.

3. PROCESSES

a. As is warranted by the issues involved, a program/project office cost estimate and/or a cost estimate made by an independent review team may be required in support of any of the instances listed in

paragraph 2.a. above. In these instances, the requirements for cost estimates shall be appropriately tailored for the purposes of the review as established by the official requesting the estimate.

b. Two separate cost estimates shall be prepared prior to initiation of design and development (Phase C/D):

(1) One estimate shall be prepared by the program/project office using appropriate estimating techniques to establish resources input in terms of labor, materials, and other direct and indirect costs and fees.

(2) A second estimate shall be prepared by an independent cost estimating team using appropriate estimating techniques.

c. All program cost estimates shall project total cost through the life cycle (see Figure 5-A-1), shall be summarized by program phase in accordance with the current WBS, and time-phased by government fiscal year (FY).

d. For each cost estimate, all major groundrules and assumptions regarding key cost parameters will be documented and justified. This should include assumptions regarding technology readiness, use of off-the-shelf hardware, complexity, use of in-house civil service resources, etc.

e. New start estimates shall be prepared in constant FY dollars accrued cost based on the expected new start program year.

(1) The Office of the Comptroller shall maintain, and update at least annually, a New Start Research and Development Inflation Index ("New Start Index") that shall be used to convert to and from constant fiscal year dollars and real year dollars, for new start estimates.

(2) When used to compare competing alternatives, e.g., different proposals from the same or competing contractors, the net present value of each alternative shall be used by discounting the real year cost plan using the discount rate and methodology guidance consistent with reference (a).

f. In order to assist in the development and refinement of cost estimating techniques, at the completion of Phase D, the program manager shall report time-phased elements of cost and technical parameters in a format specified by the CFO/Comptroller.

g. Each program/project will maintain a history of the cost estimates that is traceable to the program assumptions and the external influences as part of the permanent program record and available for subsequent audit.

CHAPTER 5

SECTION G

RESOURCE MANAGEMENT

The Resource Management (RM) function is comprised of: planning, monitoring, and controlling cost, workforce, and facility requirements; correlating these requirements to technical and schedule performance; and comparing these parameters to baselines established for the program. The RM function establishes, monitors and updates budget, commitment, obligation and cost baselines, as well as the workforce baseline. This includes generating resource impact estimates for major changes, alternative planning, schedule adjustments, new requirements, rebalancing between elements, and/or budget limitations. The key elements of RM are:

- Resource Requirements,
- Budget Development and Administration,
- Funds Control, and
- Contractor Financial Reporting and Performance Measurement Systems.

RESOURCE REQUIREMENTS

1. PURPOSE

   a. To determine the level of resources required for the execution of the program/project throughout the life cycle.

   b. To determine the institutional resources requirements that occur outside the program/project life cycle, but are necessary to the efficient completion of the program objectives.

2. POLICIES

   a. The PAA shall assure that all elements of cost of a program are accurately estimated, consistent with the program/project technical and schedule plans and are submitted for budget consideration. These estimates are updated as necessary throughout the life of the program/project.

   b. The CFO/Comptroller shall assure that resources requested by the PAA conform to existing standards, laws and regulations.

3. PROCESSES

   a. The program/project manager will prepare resource estimate in accordance with the procedures in Chapter 5.F.

   b. Estimates will be included for all elements of cost within the program life cycle. (See Figure 5-A-1)

      (1) Estimates will be time phased by FY.

      (2) Estimates should be projected by WBS element at the appropriate level, and by organizational element at the appropriate level.

   c. Additional estimates will be projected by FY that are not included within the program life cycle. These include:

      (1) Civil service workforce full-time equivalents (FTE), and

      (2) Undistributed facility usage levels.

BUDGET DEVELOPMENT AND ADMINISTRATION

1. PURPOSE

   a. Ensure the implementation of approved programs and any proposed new programs are consistent with Agency planning and projected resources availability.

   b. Develop recommendations that support priorities of Agency management, contain a reasonable estimate for the work proposed, and have a reasonable chance for approval.

   c. Support the recommended budget submission to OMB and Congress including documentation, justification, hearings and responses to questions.

   d. Ensure that program execution during the operations year is consistent with the approved plan.

   e. Monitor progress against the approved plan.

   f. Reallocate resources if necessary.

2. POLICIES

   a. NASA will prepare and submit a program budget each year in accordance with the procedures contained in references (b) and (c). Each PAA is responsible for developing estimates for each program in accordance with the Agency Wide Coding Structure that will support the request to OMB and Congress for funding authority for each phase of the project life cycle.

   b. Each PAA is responsible for preparation of the necessary support documentation and to act as an advocate for his or her proposed new starts, on-going programs and adjustments to baselines.

   c. The CFO/Comptroller is responsible for the release of resource allocations and resources authority in accordance with the approved operating plans.

   d. Each PAA will monitor the progress of his or her programs to assure that commitment agreements are met, or that variances are identified and resolved at the earliest possible time.

3. PROCESSES

   a. Annually, the CFO/Comptroller, after consultation with the Administrator, will issue program guidelines and budget submission instructions to the PAA. The PMC will

review all new Phase B proposals and provide guidance on those that can reasonably be expected to be funded.

b. In accordance with the instructions from the CFO/Comptroller, the PAA will prepare and forward a program budget request for each approved program under his or her cognizance. See Figure 5-G-1.

(1) Using the CFO/Comptroller guidelines as a basis, the PAA will request a Program Operating Plan (POP) from the field installations for each program under his or her cognizance, as well as the funds required for program research, technology and program support.

(a) The field installation project manager will prepare a POP that will be time-phased according to the CFO/Comptroller and PAA instructions, and:

- Realistically projects the NOA and cost required to proceed according to the Project Plan.

- Identifies any over-guideline requirements and associated impact statements assessing the risk to technical performance or program schedules due to lack of required funds.

- Is structured to minimize the risk associated with the normal fluctuations in available funding as a result of the authorization, appropriation and apportionment process.

(b) The project manager will include a projection of the total LCC of the project, which should be made a part of updated Project Plans, commitment agreements and other documentation, when required.

(2) If appropriate, the PAA will submit requests for program authority for programs entering Phase B or Phase C/D.

(3) If necessary, the PAA will request program authority that exceeds either the program guidelines issued by the CFO/Comptroller or the PCC as an increment in excess of the budget guidelines.

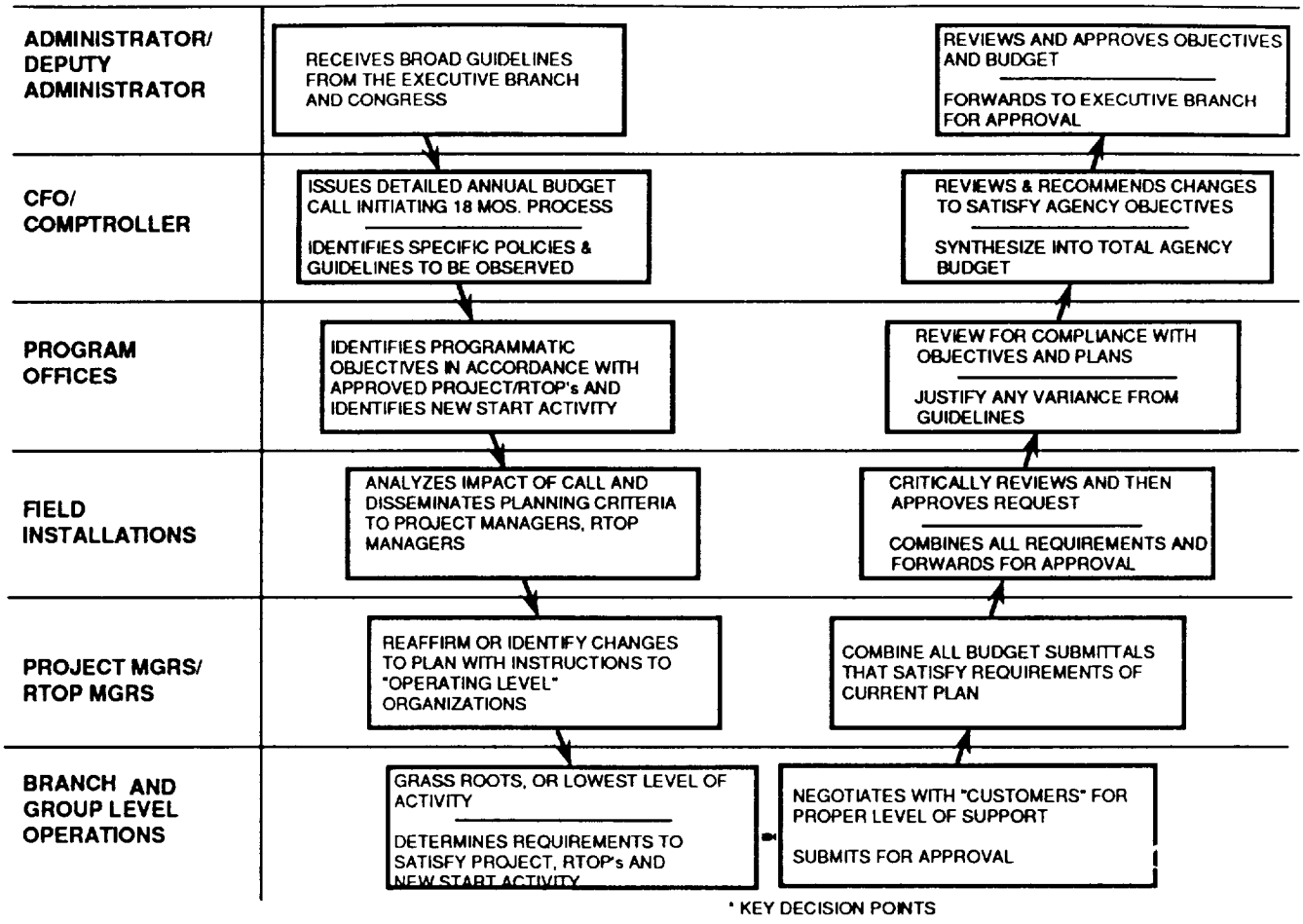

Figure 5-G-1 Program Budget Process

c. Once approved by the Administrator, the PAA will prepare the necessary documentation to support the advocacy of the NASA Budget Request to both the OMB and Congress.

d. If necessary, the CFO/Comptroller, in consultation with the Administrator, will make adjustments to the levels submitted in the NASA Budget Request to reflect changes enacted by Congress. This approved budget will form the basis for the Agency operating plan.

e. When appropriated and authorized by Congress, and apportioned by the OMB, the CFO/Comptroller will allocate funds to the programs in accordance with the Agency operating plan.

f. Each PAA will assure the day-to-day execution and monitoring of his or her programs within the Agency operating plan and report variances periodically.

(1) Variance notifications should address the level to which program commitments are threatened and options for recovery, if necessary.

(2) The CFO/Comptroller will reallocate funds as necessary after obtaining necessary Agency and Congressional approvals.

FUNDS CONTROL

1. PURPOSE

Funds Control assures use of program and institutional funds for the purposes authorized and appropriated by Congress and apportioned by the OMB.

2. POLICIES

a. The NASA Administrator shall execute programs within the funding constraints of Congress and the President.

b. The CFO/Comptroller shall control and distribute all funds to the extent funds are available through the apportionment of the OMB. The authority to further control these funds may be delegated to the Comptrollers of NASA field installations.

c. The PAAs shall execute the programs under their cognizance within allocated funds.

d. The NASA Inspector General shall review fiscal transactions and program execution to assure compliance with the NASA appropriations and authorizations, as well as the Space Act and other laws and regulations.

3. PROCESSES

a. Resources allotments (504) are issued by the CFO/ Comptroller to the appropriate field installation from funds apportioned by the OMB. (See Figure 5-G-2.)

b. Resources authority (506 Green) is issued to the PAA in accordance with the Agency operating plan.

c. Resources authority (506 White) is issued to the field installation by the PAA.

d. Each field installation maintains an internal control system to assure that authority is available before commitment, obligation, cost or disbursement of funds, maintaining data in a manner that facilitates audit of all transactions.

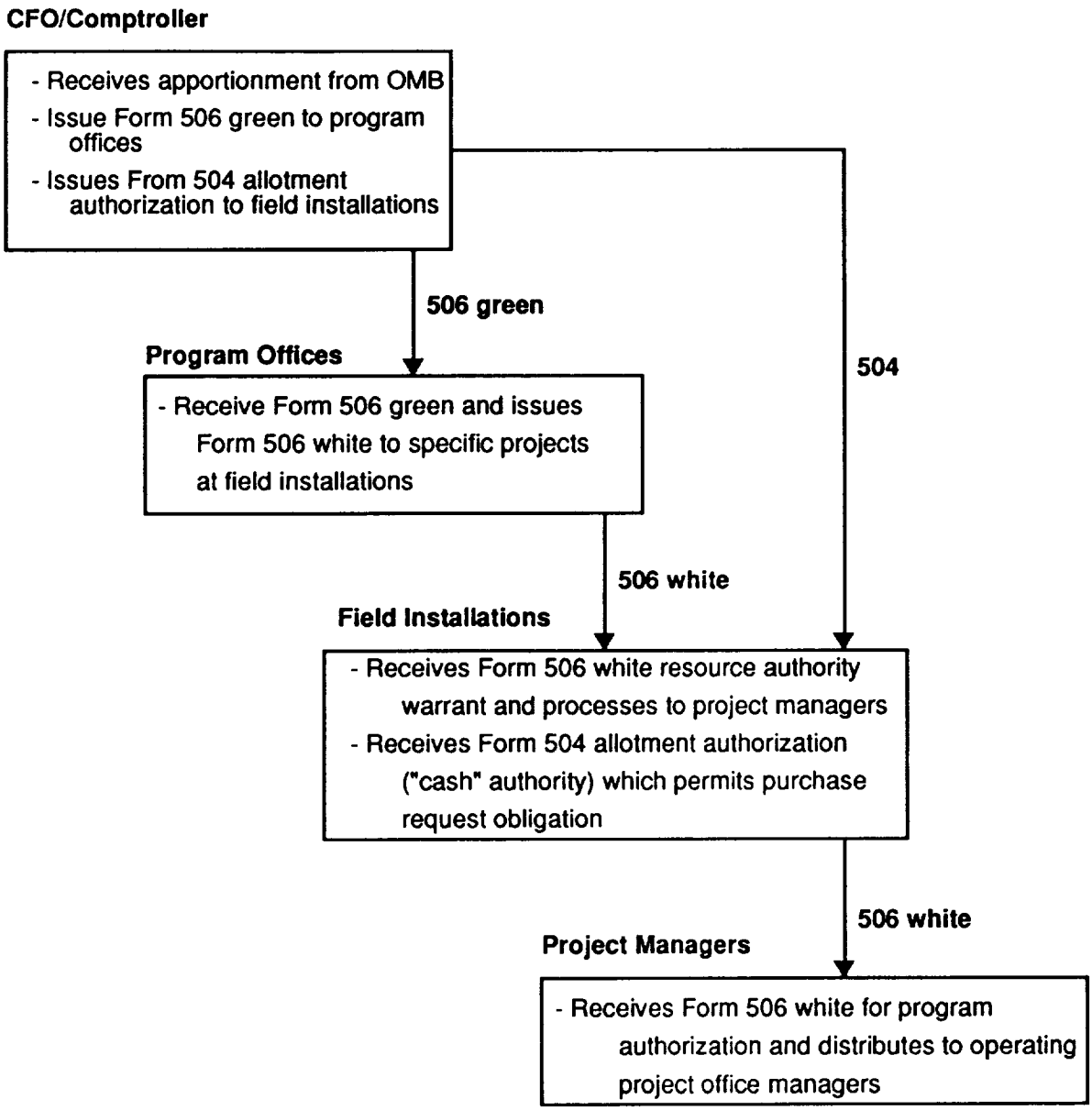

Figure 5-G-2 Funds Control Process

CONTRACTOR FINANCIAL REPORTING AND PERFORMANCE MEASUREMENT SYSTEMS

1. PURPOSE

These policies and processes establish the basis for the application of cost reporting and performance measurement requirements to contracts under major programs and projects. The purpose of these requirements is to provide contractor and NASA program/project managers with data sufficient to monitor execution of their program/project and to:

a. Assess progress against plans and complinace with technical, schedule, and cost baselines and commitments, and

b. Provide early warning of potential problems.

2. POLICIES

a. Contractor cost reporting and performance measurement requirements shall be applied to contracts in accordance with references (e), (f), and relevant field installation management instructions.

b. Contractors' internal accounting and reporting systems shall include policies, procedures and methods that are designed to accomplish the requirements in reference (f).

c. Contractor reporting must be of sufficient detail to allow the PAA to:

(1) Assess project progress and conformance to the PCA.

(2) Fulfill the requirements of NMI 2340.3, "Implementation of Contractor Metrics" (reference (m)).

3. PROCESSES

a. Contractor cost reporting and performance measurement is required and will be accomplished in accordance with references (e), and (f), and will be of sufficient depth to support the required program control, verification and internal and external reporting requirements of NASA.

(1) The contractor must report to a level that will allow the program/project manager to review the cost expended on the program/project in relation to the schedule and technical progress and determine the critical elements of risk to the program/project.

(2) The program/project manager must be able to report progress compared to the Project Plan.

(3) The PAA must be able to report compliance with the PCA.

b. Contractor cost data is used within NASA to fulfill financial management, contract management, program control and resources acquisition functions and therefore must be reported accurately by the contractor and entered into NASA systems in a timely fashion. Cost, schedule and technical performance data provided to NASA will be summarized directly from the same systems used for internal contractor management.

CHAPTER 5

SECTION H

CONFIGURATION MANAGEMENT

1. PURPOSE

The Configuration Management (CM) function establishes a formal and disciplined system for identifying, controlling, accounting and verifying hardware and software requirements and configuration through the life cycle. This function provides a disciplined approach for control of plans, requirements and the configuration of hardware and software throughout the life cycle of the program/project. The function consists of four distinct practices:

- Identification - The definition and establishment of the baseline plans, requirements and configuration items to be controlled;
- Control - The formal process used to assure discipline in making changes to the baseline. This control is effected through formal configuration control boards.
- Accounting - Definition and reporting of the exact baseline on a continuing basis and provision of a clear audit trail from the authorization of changes to the affected documentation and products. Accounting provides the single authoritative source for definition of the configuration baseline.
- Verification - Verification that the baseline configuration requirements have been incorporated into products and are tested accordingly.

2. POLICIES

a. An effective CM program shall be implemented at the earliest stages of all projects and programs. The results of Phase A should include a documented CM plan for implementation in Phase B. This then becomes the basis for all follow-on phases for a configuration item's life cycle.

b. It is the program/project managers responsibility to ensure that CM policies, processes and procedures are implemented as early as possible for all programs within the purview of this Instruction.

c. The established CM system must enable:

(1) Identifying, documenting and verifying the physical and functional characteristics of a configuration item.

(2) Ensuring that all documented configuration item requirements are traceable and verifiable to their origin and their lower tier allocation and to its origin. A parent-child relationship of configuration item requirements shall be established and maintained for the life cycle of the configuration items.

(3) Controlling changes to an item and all of its associated documentation in a synchronized manner.

(4) Status accounting and reporting the status of an item's configuration and its related documentation, including documentation of the configuration dependent activities (spares, handbooks, contracts, test documentation etc.).

(5) Auditing the configuration item and its configuration identification.

d. Configuration management shall be applied to any item:

(1) Developed wholly or partially with NASA funds, including non-developmental items when the development of technical data is required to support off-the-shelf equipment or software, or

(2) Designated for CM for the reason of integration, logistics support, operations support, interface control or safety critical considerations.

3. PROCESSES

a. Configuration Management Procedures.

(1) Configuration management procedures shall be tailored to be consistent with the complexity, criticality, quantity, size and intended use of the items. Standard processes shall be used through the tailored application of relevant military standards (references (g) through (j)), adapted to specific program characteristics.

(2) Program/project managers shall apply and maintain CM activities during all phases of the program. These activities shall be transferred to the user, logistics or identified sustaining engineering organization upon configuration item management transfer from the program/project manager.

(3) When the program development team includes non-NASA organizations (e.g., international participants or partners), the designated NASA lead institution or organization shall develop mutual agreements and a standardized set of CM procedures and processes, which are acceptable to all participants. Such processes shall function within the prescribed NASA restrictions of technical information exchange and data transfer.

b. Configuration Items. A configuration item is defined as an aggregation of hardware and/or software and related documentation that satisfies an end use function and is designated by NASA for separate CM. This includes any item required for logistics support and designated for separate procurement.

(1) Configuration items shall be directly traceable to the WBS.

(2) Computer hardware and software shall be treated as configuration items. Computer software shall be treated as configuration items throughout the life cycle of the program regardless of how the software shall be stored (e.g., read-only memory devices, magnetic tape or disc, compact disc, non-volatile random access memory, laser disc devices).

c. Configuration Baselines. Configuration baselines shall be used to ensure an orderly transition from one major commitment point to the next. These commitment points are normally major program/project controlled milestone points (See Chapter 2). Configuration baselines (functional, allocated, and product) may be identified, documented, and maintained in accordance with MIL-STD-490 and/or MIL-STD-973 (reference (g) and (h)), or other applicable sources.

d. Configuration Identification. Configuration identification may be prepared in the form of technical documentation in accordance with MIL-STD-490 and MIL-STD-973 (reference (g) and (h)), or other applicable sources.

e. Change Control. Configuration changes may be controlled in accordance with MIL-STD-973 (reference (h)), or other applicable sources, to identify the impact of proposed changes to functional and physical characteristics and approved configuration identification.

f. Configuration Status Accounting. Configuration status accounting shall provide closed-loop tracking of configuration identification changes and document the configuration of items. Configuration status may be

documented through tailored application of MIL-STD-973, DoD-STD-2167 and DoD-STD-2168 (references (h), (i) and (j)), or other applicable sources.

g. Configuration Item Development Records. Configuration records for each configuration item shall be established when the applicable configuration baseline is established. These records shall include both current and historical information to ensure traceability from the initial baseline requirement is maintained.

h. Configuration Audits. Configuration audits shall verify and document that the configuration end item and/or configuration item and its configuration identification agree (as-designed to as-built comparison), are complete and accurate, that all waivers and deviations are identified, and satisfy program requirements. MIL-STD-973, DoD-STD-2167 and DoD-STD-2168 (references (h), (i) and (j)) contain procedures for conducting configuration audits.

CHAPTER 5

SECTION I

TECHNICAL DATA MANAGEMENT

1. PURPOSE

The technical data management function establishes a formal and disciplined system and responsibilities for generating, identifying, controlling, distributing and reporting of engineering and technical management information required to support a program/project. Technical data management policies and processes are provided to ensure that the most cost effective methods and procedures are established for identification, procurement, receipt, acceptance and maintenance of technical data procured from the contractor or prepared and delivered within NASA.

2. POLICIES

a. The NASA project office having management responsibility for an item shall ensure that the Government has complete access to the data necessary to support the essential requirements of all users throughout the item's life cycle. This access may be achieved by:

(1) Procuring, storing and maintaining the necessary data in a Government data repository; or

(2) Procuring access to the data through a contractor integrated technical information service.

b. Only the minimum data needed to permit cost-effective support of research, development, production, cataloging, provisioning, training, operation, maintenance and related logistics functions over the life cycle of the item shall be acquired.

c. Data shall be ordered in contractor format unless the Government format is necessary or more cost-effective. Maximum use will be made of commercial technical manuals, or their modifications, that meet NASA requirements.

3. PROCESSES

a. Establishing Data Requirements

(1) A technical data package shall include all engineering drawings, associated lists, process descriptions, and other documents which define the

physical geometry, material composition, performance characteristics, manufacture, assembly and acceptance test procedures.

(2) User data requirements shall be established by use of a "Data Call" to all potential users (per reference (j)).

(3) Standard Data Requirements Descriptions (DRDs) or Data Item Descriptions that exceed the requirements of the data needed shall be tailored. Tailoring may be accomplished to accept contractor format, or reduce the scope through deletion, unique modification or selection of existing words, paragraphs or sections.

(4) Contract provisions shall:

(a) Ensure that contractors and subcontractors prepare and update technical data packages as an integral part of their design, development, and production effort; and

(b) Define the contractor's responsibility for accuracy and completeness of technical data packages and technical manuals.

(5) All technical data and technical manuals shall be updated to reflect approved design changes and made available concurrent with the implementation of the change.

(6) Contract deliverable data shall be prepared and used in electronic form unless it is not cost-effective for the Government. Maximum use should be made of available contractor automated databases.

(7) When options are established for delivery of digital data, the program office shall ensure that all the recipients of the electronic data have the necessary capability to receive, store and maintain the data.

(8) Logistics support analysis data shall be used to the maximum extent to define and develop source data for technical manuals.

b. Planning for New Technical Manuals. Plans shall be developed for technical manuals to ensure support to all end items, system, system component, support equipment or test support equipment. These plans shall:

(1) Provide means for ensuring the technical accuracy and adequacy of technical manual content.

(2) Provide for the optimum number and types of conventional publications and other media such as audiovisual systems, tape, disc or other electronic devices; and

(3) Establish a clear definition of:

(a) Contractor responsibility for accuracy and completeness of technical manuals; and

(b) Contractor and NASA participation in validation and verification.

c. Data Acquisition Documents. Specific requirements for the preparation of deliverable data or for record keeping are to be documented in specifications, standards, and DRDs, collectively known as data acquisition documents.

(1) Data requirements in solicitations and contracts shall be reflected in DRDs.

(2) DRDs shall not be used to delineate requirements for technical manuals for systems, configuration end items, subsystems components, or support equipment. These manuals shall be acquired by line item and have an exhibit attached to the acquisition document.

(3) The acquisition of technical manual administrative and/or management data, such as status reports, validation plan schedules, and manuals other than those to support a configuration end item and/or system shall be acquired by DRD.

d. Ordering, Delivery, Inspection and Acceptance of Data. Data shall be ordered, delivered, inspected and accepted in accordance with the FAR and NASA FAR Supplement.

e. Rights in Data. Acquisition of rights in technical data shall be in accordance with the FAR and NASA FAR Supplement.

f. Warranty of Data. Acquisition of data warranties shall be in accordance with the NASA FAR Supplement.

g. Distribution Statements on Technical Data. Technical data shall be marked in accordance with the NASA FAR Supplement and MIL-STD-1806 (reference (1)) to denote the extent to which the data may be distributed without further approval of the controlling NASA office.

h. Data Repositories. Technical data packages, software media and associated data shall be received, inventoried, inspected, accepted, indexed, stored and managed to provide maximum accessibility to NASA projects, programs and installations, and to ensure that contractor data rights are protected.

i. Release of Data. To the maximum extent allowable by law and regulation, NASA field installations shall provide, or make available, requested data in accordance with applicable portions of the FAR and NASA FAR Supplement.

CHAPTER 5

SECTION J

PERFORMANCE ASSESSMENT

1. PURPOSE

Program assessment correlates the impacts of cost, schedule and technical performance on the ability to successfully meet the commitments contained in the various program/project control documents and agreements.

2. POLICIES

a. The program/project manager shall install and operate an effective system of performance asessment.

b. The PAA shall institute a system of routine controls to assure optimal use of program resources on a particular program/project.

c. The CFO/Comptroller shall independently validate the performance of the program/project throughout its life cycle.

3. PROCESSES

a. The program/project manager will develop the necessary tools to monitor and correlate the cost, schedule, and technical performance elements of the program.

(1) In order to effectively analyze performance, meaningful cost, schedule and technical performance baselines must be established:

(a) In conformance with the program WBS at a level sufficient to assure visibility into the critical path of the program; and

(b) Consistent with higher-level program commitments.

(2) The "earned value" methodology for correlating accrued cost to work accomplished is required to perform this assessment.

(3) The project office is encouraged to utilize standard contractor reporting systems that will provide the required data in sufficient detail for analysis purposes. (See Chapter 5.g).

(4) Each program/project manager shall establish a set of cost, technical and schedule metrics related to program/project commitments. These metrics shall include a control target and tolerance band around the time-phased plan that establishes acceptable values given the program/project's phase of the life cycle.

(5) The program/project manager shall periodically report the metric values of these trends, consistent with controlled activities and commitments.

b. The cost, schedule and technical commitments and associated control targets established in PCA documents will be the basis for triggering review actions by commitment approving authorities.

c. Programs and projects shall hold cost, schedule and technical reserves within the thresholds and report on the margins periodically. These reports shall include usage and status of the APA and contingency reserves.

d. For programs required to provide PSR's, as defined in GAO Report B-237602, "Project Status Reports" (reference (o)), the appropriate PAA shall report data necessary for preparation of the PSR's to the CFO/Comptroller. The CFO/Comptroller shall provide the completed PSR's to the appropriate congressional committees.

CHAPTER 6

RISK MANAGEMENT

References: (a) NASA Technical Manual 100311, Program Risk Analysis Handbook, August 1987.

1. PURPOSE

Risk management comprises purposeful thought to the sources, magnitude and mitigation of risk, and actions directed toward its balanced reduction. As such, risk management is a continuous process that is an integral part of program and project management at all levels. This chapter:

a. Defines NASA policy on risk management,

b. Defines risk and describes the categories of risk,

c. Describes the concepts of risk management,

d. Defines the minimum content that a Risk Management Plan must contain, and

e. Defines the management forums that will review and validate a program/project's Risk Management Plan.

2. POLICIES

Program/project management shall:

a. Plan and implement a disciplined approach to risk management throughout the program/project life cycle by preparing and maintaining a Risk Management Plan,

b. Support management decision making by providing integrated risk assessments (i.e., taking into account technical, programmatic, supportability (including dual sources), cost and schedule concerns),

c. Communicate to NASA management and all program/project personnel the significance of assessed risks and the decisions made with respect to them.

3. PROCESSES

a. Risk Definition/Categories.

(1) Risk Definition. Risk is defined as the likelihood of an undesirable event occurring and the severity of the consequences of the occurrence.

RISK CATEGORIES				
TECHNICAL	PROGRAMMATIC	SUPPORTABILITY	COST	SCHEDULE
Physical Properties	Material Availability	Operability	Sensitivity to Technical Risk	Sensitivity to Technical Risk
Material Properties	Single Source Suppliers	Reliability Maintain-ability	Sensitivity to Programmatic Risk	Sensitivity to Programmatic Risk
Radiation Properties	Personnel Availability	Reusability	Sensitivity to Supportability Risk	Sensitivity to Supportability Risk
Testing/ Modeling	Personnel Skills	Training	Sensitivity to Schedule Risk	Sensitivity to Cost Risk
Integration/ Interface	Interprogram Conflicts	Operations & Support Equipment	Overhead/G&A Rates	Degree of Concurrency
Software Design/Errors	Security	Spares	Estimating Error	Number of Critical Path Items
Reliability	Environmental Impact	Workforce Considerations	Economic Inflation	Estimating Errors
Safety	Communication Problems	Critical Facilities		
Requirement Changes	Labor Strikes	Inter-operability Considerations		
Fault Detection/ Tolerance	Requirement Changes	Transport-ability		
Operating Environment	Political Advocacy			
Proven/ Unproven Technology	International Involvement	Technical Data		
System Complexity	Contractor Capability and Stability			
Unique/Special Resources	Funding Profile			
Hardware Aging	Regulatory Changes			
Manufacturing Processes	Multicenter Involvement			
Quality	Multiagency Involvem ent			

Table 6-1. Typical Sources of Risk

(2) Risk Categories. Program/project risk can be segregated into five categories:

(a) Technical

(b) Program,matic,

(c) Supportability,

(d) Cost, and

(e) Schedule.

(3) Understanding and classifying a risk into one or more of the five categories requires an examination of the sources of the risk. Although it is not always easy to determine to which category a particular risk belongs, understanding the sources of risk and the associated impact area(s) are critical if risk is to be managed effectively. Table 6-1 depicts typical risk sources by risk category.

b. Concepts of Risk Management.

(1) Risk management is a continual process that is an integral part of project planning and management and is updated as new information becomes available. Some of the more obvious times for revisiting risk issues include:

(a) In preparation for major decision points and program/project milestones,

(b) In preparation for and immediately following technical reviews and audits,

(c) Concurrent with review and update of program/project changes and impacts (design changes, test successes or failures, etc.), and

(d) In preparation for budget reviews.

(2) As shown in Figure 6-1, there are four elements that make up the risk management process. These four elements are overlapping activities that span the program/project life cycle as shown in Figure 6-2 and described below.

(a) Risk Planning. The first element of the risk management process is risk planning. The purpose of risk planning is to force organized purposeful thought to eliminating, minimizing, recognizing or containing the effects of undesirable occurrences during the program/project life cycle. A Risk Management Plan is required to communicate the plan for managing risks.

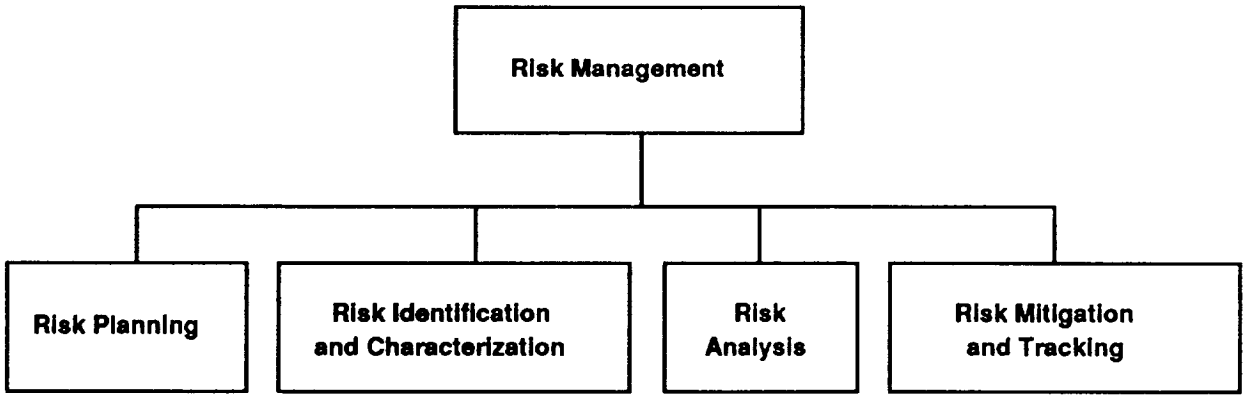

Figure 6-1. Risk Management Structure Diagram

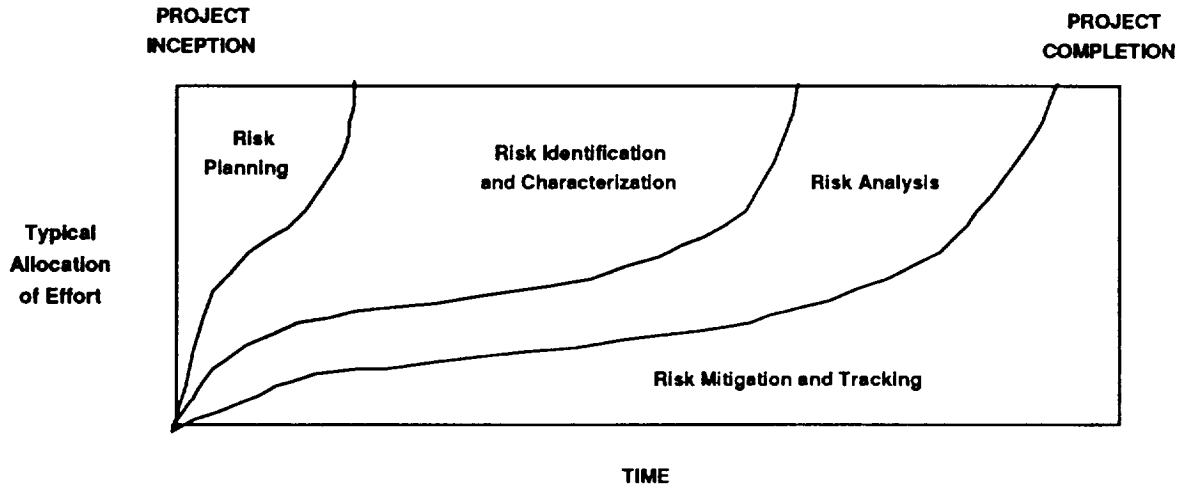

Figure 6-2. Risk Management Process Time Phasing

(b) Risk Identification and Characterization. The second element of the risk management process is to identify and characterize program/project risks. The objective of this step is to understand what uncertainties the program/project faces, and which require greater attention. This is accomplished by categorizing (in a consistent manner) uncertainties by the likelihood of occurrence (e.g., high, medium or low), and by the severity of consequences. This categorization forms the basis for ranking uncertainties by their relative riskiness. This may be depicted using a risk diagram (an example is shown in Figure 6-3). Uncertainties with both high likelihood and severely adverse consequences are ranked higher than those without these characteristics. The primary methods used in this process are qualitative;

hence, this step is sometimes called qualitative risk assessment. The output of this step is a list of significant risks (by phase) to be given specific management attention.

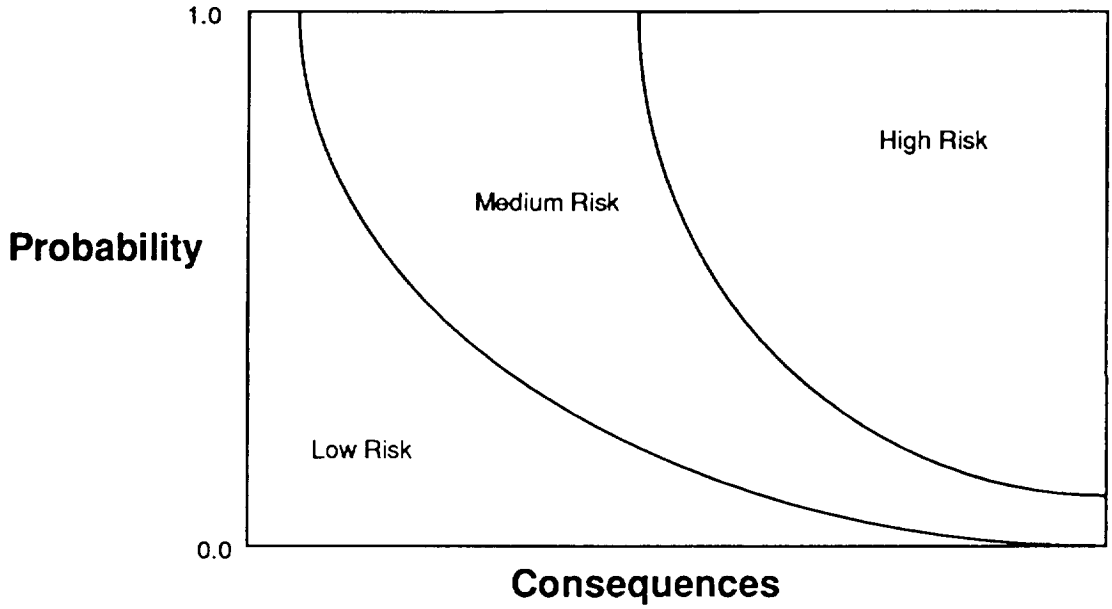

Figure 6-3. Risk Diagram

(3) Risk Analysis. The third element of the risk management process is quantitative and probabilistic. In some programs/projects, qualitative methods (as in (2), above)are adequate for making risk management decisions; in others, these methods are not sufficient to understand the problem, or to allocate scarce risk reduction resources. Probabilistic risk analysis is the process of quantifying the likelihood of occurrence, consequences of potential future events, as well as attendant uncertainties. The program/project manager needs to decide if risk identification and characterization are adequate, or if probabilistic risk analysis is needed to support decision-making. In making that determination, the program/project manager needs to balance the possibly higher cost of probabilistic risk analysis against the value of its benefits.

(4) Risk Mitigation and Tracking. The fourth element of the risk management process is risk mitigation and tracking. Risk mitigation is the formulation, selection and execution of strategies designed to economically reduce risk. Tracking the

effectivenss of the strategies is also considered part of risk mitigation. Risk mitigation is often a challenge because efforts and expenditures to reduce one type of risk may increase another type. The ability (or necessity) to trade one type of risk for another means that the program/project manager and all personnel working the program/project need to understand the systemwide effects of various strategies in order to make a rational allocation of resources.

c. Risk Management Techniques. Techniques have been developed for each area of the risk management process. The program/project manager needs to choose the techniques that best fit the unique requirements of his/her program/project. Table 6-2 illustrates a few of the many techniques available to the program/project manager.

RISK IDENTIFICATION AND (QUALITATIVE) CHARACTERIZATION	RISK ANALYSIS (QUANTITATIVE & PROBABILISTIC)	RISK MITIGATION AND TRACKING
Project Team Assessments	Decision Analysis	Watch Lists/ Milestones
Expert Interviews	Expert Interviews	Contingency Planning
Independent Assessment (Cost, Schedule and Technical)	Probabilistic Network Schedules (e.g., PERT)	Descope Planning
Risk Templates	Probabilistic Cost and Effectiveness Models (e.g., Monte Carlo Models)	Parallel Development Allocation of Resources for Strategy Implementation
Lessons Learned From Previous Projects	Fault Trees/Event Trees	Critical Items/ Issues Lists & Retention Rationale
FMECAs/FMEAs/ Digraphs Fault Trees		Cost/Schedule Control Systems and Technical Performance Measure (TPM) Tracking
		Technical Margins
		Cost and Schedule Reserves

Table 6-2. Techniques of Risk Management

d. Risk Management Plan Content.

The content of the program/project's Risk Management Plan may be tailored to the needs of that

program/project but shall contain, as a minimum:

(1) A characterization of all specific risks identified for the program/project, including technical, programmatic, supportability, cost and schedule risks,

(2) A description of the methodologies and processes used to identify, assess and analyze the program/project risks,

(3) A description of the plans for mitigating and tracking the program/project risks, including appropriate descope plans and technology development plans, with supporting rationale,

(4) A delineation of responsibilities within the program/project for the implementation of the risk mitigation and tracking plans.

The Risk Management Plan may be a separate document or segmented among other project planning documents.

e. Risk Management Forums.

(1) A program/project's Risk Management Plan shall be a part of the program/project documentation required to support management reviews.

(2) The NAR Team and the PMC, shall use the Risk Management Plan as one of the deciding criteria to determine the readiness of a program/project to continue into the next phase of the life cycle.

(3) The NAR Team shall use specific criteria to assess and validate the content covered in a program/project's Risk Management Plan and shall provide to the PMC an assessment of the Risk Management Plan along with any recommendations for the PMC's consideration as part of the program/project approval process. In addition, the NAR Team shall provide feedback on the Risk Management Plan to program and project management following completion of the Preliminary NAR and NAR and prior to presentation of its findings to the PMC.

CHAPTER 7

ENGINEERING

The policies and processes presented in this chapter establish a common frame of reference for developing program/project plans in the engineering disciplines.

The policies and processes are organized and presented as follows:

SECTION	SUBJECT
A	Design for Fabrication
B	Software Engineering
C	Human Factors
D	Integrated Logistics Support Implementation
E	Use of the Metric System
F	Technical Standards

CHAPTER 7

SECTION A

DESIGN FOR FABRICATION

1. PURPOSE

These policies and processes establish the basis for effectively integrating the design and production engineering efforts, so the system and its associated fabrication processes can be designed, developed and (where practical) tested concurrently.

2. POLICIES

a. The producibility of the design shall be a priority of the engineering development effort, particularly when products are designed to advance the state of the art.

b. Rigorous assessment of design and associated fabrication process risks and continuous application of effective risk reduction measures shall be performed throughout all program phases.

3. PROCESSES

As an integral part of detailed design, the fabrication processes necessary to produce a system should be identified. Fabrication risks should be identified and evaluated, so risk abatement can be planned and executed. A risk assessment will be made on the capability of contractors and critical subcontractors to perform fabrication process and to meet cost and schedule commitments. This assessment will include consideration of the past performance and quality history of the contractor and critical subcontractors. The effects of new product or material technology on fabrication are to be addressed as part of this effort. This approach:

a. Identifies effective fabrication processes and product design features that enhance producibility. Efforts should target design simplification, design for assembly and inspectability, design for piece part producibility, and design for system integration and test.

b. Reviews the design's use of hazardous materials and investigates use of alternative materials.

c. Identifies and enhances critical product producibility features and associated fabrication processes, such as design fabrication tolerances and process control limits.

d. Develops developmental test strategies and plans that provide for proofing or validating fabrication processes.

The fabrication risk assessment will be documented in the source selection process. Fabrication risks will be subsequently covered in the PDR for long lead-time items, and in the CDR for all other items.

Engineering efforts will be organizationally structured to ensure close working relationships between engineering design, quality and fabrication functions.

CHAPTER 7

SECTION B

SOFTWARE ENGINEERING

References: (a) NMI 2410.10B, "NASA Software Management, Assurance and Engineering Policy"
(b) NASA-STD-2100-91, "NASA Software Documentation Standard"

1. PURPOSE

These policies and processes establish the basis for integrating the software elements of a program/project into the total technical effort to meet the program cost, schedule and performance objectives.

2. POLICIES

a. Program/project software shall be integrated into the total technical effort in accordance with the engineering policies and processes.

b. Software elements shall be developed and maintained with sufficient attention to reliability and maintainability policies and processes, as described in Chapter 8.A, to meet both performance and life cycle cost objectives.

3. PROCESSES

a. A Software Management Plan (SMP) shall be developed and finalized no later than the end of Phase B. The SMP should identify all software elements (including any onboard software for flight systems) necessary to perform system operations, or software used to conduct the major system-level testing, which might cause failure or seriously degrade system performance or adversely affect personnel safety. The SMP should identify any common software elements and any interfaces between software elements. The criticality of each software element to safety and to project success should also be identified. Based on this, the SMP will document:

(1) Organizational responsibilities and authority for software engineering management, control methods (e.g., for engineering changes) and technical progress tracking methods (e.g., Technical Performance Measurement) to be used.

(2) The software engineering process, including the

system design process, risk management process, trade study process, methods and/or models to be used for system cost-effectiveness evaluations, life-cycle cost management process, and any specific tailoring of these processes to the requirements of the system.

(3) Integration and coordination of the required technical specialty disciplines into the software engineering process.

(4) Key software engineering milestones and schedules.

(5) Criteria for the selection of common development methods, tools or training.

(6) Criteria for the selection and use of commercial-off-the-shelf software and other inherited software.

(7) Any internal review or inspection processes that are in addition to reviews that apply to the entire program/project.

(8) Criteria and processes for incorporating upgrades, including: operating systems, languages, processors and other software related equipment, applications that project software must interface with, and applications developed within the program/project.

b. Software configuration management should be in accordance with the policy and processes of Chapter 5.

c. Software reliability, maintainability and quality assurance should be integrated with the project requirements.

CHAPTER 7

SECTION C

HUMAN FACTORS

References: (a) NASA STD-3000, Volume 1, "Man-Systems Integration Standards"
(b) MIL-H-46855, "Human Engineering Requirements for Military Systems, Equipment, and Facilities"
(c) MIL-STD-1472, "Human Engineering Design Criteria for Military Systems, Equipment, and Facilities"

1. PURPOSE

These policies and processes establish the basis for integrating the discipline of human factors into system development efforts. The purposes of human factors include:

a. Improving system performance,

b. Reducing workforce, training requirements and operations costs, and

c. Reducing or eliminating critical human performance errors.

2. POLICIES

For performance critical and safety critical functions:

a. Human factors aspects of system designs shall be as simple as possible, consistent with the functions desired and the expected service conditions.

b. Systems shall be designed to standardize human factors aspects of hardware and software.

c. The cost effectiveness of alternative human-machine interface designs shall be analyzed in order to reduce both operational errors and LCC.

3. PROCESSES

a. Human factors requirements should be established during Phase B. For crewed flight projects, these requirements will usually be tailored from reference (a). For operations facilities, requirements may be derived from procedures described in references (b) and (c), or other applicable sources.

b. Human factors inputs should be considered in project plans, system engineering plans, test plans and procedures, and contractual documentation.

c. Human factors should be integrated into the design, development and verification processes. Mockups, demonstrations, analyses and simulations should be used to validate human-machine concepts.

CHAPTER 7

SECTION D

INTEGRATED LOGISTICS SUPPORT IMPLEMENTATION

References:
(a) NMI 7500.4, "Acquisition Logistics Policy"
(b) NMI 6000.5A, "Transportation Management"
(c) NHB 6200.1, "NASA Transportation and General Traffic Management"
(d) NHB 6000.1D, "Requirements for Packaging, Handling, and Transportation for Aeronautical and Space Systems, Equipment and Associated Components"
(e) NHB 5300.4, "(1A-1), "Reliability Program Requirements for Aeronautical and Space Systems Contractors"
(f) NHB 5300.4 (1E), "Maintainability Program Requirements for Space Systems"
(g) NMI 5350.1A, "Maintainability and Maintenance Planning Policy"
(h) NMI 7232.1F, "Master Planning of NASA Facilities"
(i) 7234.1, "Facilities Utilization Program"
(j) NMI 5900.1B, "NASA Spare Parts Acquisition Policy"
(k) MIL-STD-1388, "Logistics Support Analysis"

1. PURPOSE

These policies and processes establish the basis for Integrated Logistics Support (ILS) planning and implementation to assure that systems are operable, available and affordable for operations.

2. POLICIES

a. Systems design and development shall be accomplished to ensure effective and cost efficient support of system operations.

b. NASA programs/projects will ensure effective acquisition logistics programs during all phases of the program/project life cycle.

c. Phase E ILS requirements shall be identified, reviewed and developed concurrent with system definition, design and development.

3. PROCESSES

a. Design engineers and logistics engineers should work jointly during the design and development process, to ensure satisfactory system support and affordable LCC, consistent with system requirements and resource constraints.

b. Logistics Support Analysis (LSA) techniques should be used to determine the design and management actions necessary to ensure system logistics support. LSA guidelines are found in the MIL-STD-1388 series of documents and should be tailored for application consistent with system requirements and resources constraints.

c. ILS processes to define, design, develop and acquire the support to meet system operations requirements should include definition of support in each of the following nine ILS elements:

(1) Maintenance. The process of planning and executing life cycle repair/services concepts and requirements necessary to ensure sustained operation of system elements.

(2) Design Interface. The interaction and relationship of logistics with the system engineering process to ensure that system element supportability influences the definition and design of system elements to reduce LCC.

(3) Technical Data. The recorded scientific, engineering, and technical information used to define, produce, test, evaluate, modify, deliver, support and operate a system or system element.

(4) Training. The processes, procedures, devices and equipment required to train personnel to operate and support system elements.

(5) Supply Support. Actions required to provide all the necessary material to ensure the level of supportability and usability of systems required to meet operational objectives.

(6) Support Equipment. The equipment required to facilitate development, production and operation of systems.

(7) Transportation. The actions, resources and methods necessary to ensure the proper and safe movement of system elements and materials. Included are the packaging, handling and storage of items.

(8) Human Resources and Personnel Planning. The actions required in designing systems and determining skills-mix to minimize operator, maintenance, engineering and administration personnel costs.

(9) System Facilities. Real property assets required to develop and operate system elements.

e. An ILS Plan should be prepared by the completion of Phase B and subsequently maintained. This plan documents logistics support concepts, requirements responsibilities and trade-off decisions.

(1) For major systems the ILS Plan should be a distinct and separate part of the system documentation.

(2) For smaller systems the ILS Plan may be integrated with other system documentation.

f. Reliability, maintainability and quality assurance requirements and directives are fundamental to ILS program management and shall guide ILS approaches to systems.

g. The provisioning of expendable and reparable spares should be accomplished through a tailoring of LSA and in accordance with the NASA provisioning policies.

CHAPTER 7

SECTION E

USE OF THE METRIC SYSTEM

References: (a) Executive Order 12770, "Metric Usage in Federal Programs" (July 21, 1991)
(b) NASA Metric Transition Plan (February 10, 1992)
(c) NMI 8010.2A, "Use of the Metric System of Measurement in NASA Programs" (June 11, 1991)

1. PURPOSE

These policies govern the use of the metric system of measurement on major system development programs.

2. POLICIES

a. The metric system of measurement, formally known as the International System of Units or SI system, as defined by ANSI/IEEE Standard 268 (1993), shall be the preferred system of weights and measures for major system development programs.

b. New system procurements, grants and business related activities shall use the metric system except where such use is demonstrated to be impractical or would cause significant inefficiencies in performance of NASA's mission.

c. Systems designed and built using inch units may continue use of inch units for the life of the system, but shall accommodate interfaces with systems built to metric units as required.

d. Where full use of metric units is limited by practical considerations, hybrid metric and inch pound design is acceptable, if safety and performance would not be compromised.

CHAPTER 7

SECTION F

TECHNICAL STANDARDS

References: (a) OMB Circular A119, "Federal Participation in the Development and Use of Voluntary Standards"
(b) NMI 8010.2A, "Use of the Metric System of Measurement in NASA Programs"
(c) NMI 8070.6, "Engineering Standards and Practices"

1. PURPOSE

These policies and processes concern the role of standardization and the use of standardization documents on NASA programs.

2. POLICIES

a. Standardization, the use of accepted and documented practices and materials, shall be used to the maximum practical extent, consistent with program objectives, to provide a proven technical basis for and to reduce the cost and technical risk of systems development and operations.

b. Preference in system design and specification shall be given to multi-program standards; development and application of program-specific standards will be limited to unique program requirements.

c. Preference will be given to use of non-Government, or "voluntary" standards where they can be adapted to meet program needs, as required by reference (a).

d. NASA standardization documents will incorporate metric units of measure in accordance with Chapter 7.E and reference (b).

e. Standards shall not be applied as requirements on programs before system options have been fully explored.

f. Standards shall be tailored as appropriate to meet program needs.

3. PROCESSES

Development and maintenance of NASA standardization documents shall be in accordance with reference (c).

CHAPTER 8

SAFETY AND MISSION ASSURANCE

The policies and processes presented in this chapter establish a common frame of reference for developing program/project plans in the safety and mission assurance disciplines.

The policies and procedures are organized and presented as follows:

SECTION	SUBJECT
A	Reliability and Maintainability
B	Quality Assurance
C	Safety
D	Environmental Impact
E	Nuclear Safety Launch Approval

CHAPTER 8

SECTION A

RELIABILITY AND MAINTAINABILITY

References: (a) NHB 5300.4(1A-1), "Reliability Program Requirements for Aeronautical and Space System Contractors"
(b) NHB 5300.4(IE), "Maintainability Program Requirements"
(c) NMI 5350.1A, "Maintainability and Maintenance Policy"
(d) NMI 7500.4, "Acquisition Logistics Policy"

1. PURPOSE

These policies and processes establish the basis for a comprehensive effort designed to increase system availability and reduce LCC.

2. POLICIES

a. Emphasis shall be on:

(1) Managing the contributions to system reliability and maintainability made by hardware, software and human elements of the system;

(2) Preventing design deficiencies (including single failure points), precluding the selection of unsuitable parts and materials, and minimizing the effects of variability in the fabrication processes; and

(3) Developing maintainable systems, where applicable, particularly when this enhances the cost effectiveness on a life-cycle cost basis.

b. Problem/Failure detection, reporting, isolation and correction techniques shall be used to support development and implementation of systems.

3. PROCESSES

a. Objectives for reliability and maintainability shall be defined for all elements of systems that will be used by the project.

b. Predictions and design analyses of the reliability and maintainability of all system elements shall be conducted as an element of the design process and should

be presented at PDR and CDR. Design analysis should be conducted to the extent necessary to establish acceptable reliability in all operational environments. A strategy for accomplishing reliability growth over the remaining development period should be developed, and should be considered as a factor in the preparation and assessment of reliability estimates.

c. Parts selection guidelines shall be formulated, and testing of government or contractor furnished or off-the-shelf items should be performed to ensure suitability for their intended use.

d. Reliability derating guidelines should be formulated for electronic parts, so if operational environment stresses are within guidelines, part reliability will not be degraded.

e. Software maintainability should be enhanced by applying modern software engineering practices, such as modularization, and by ensuring that software documentation is understandable, complete and compatible with the software being used.

f. Where maintainability is needed, the design features required for maintainability and the support environment for maintainability (e.g., spares, special tooling, trained personnel) should be identified by PDR and in place for operations prior to completion of Phase D.

g. Maintainability characteristics, where applicable, should be demonstrated in sufficient time to allow for cost effective changes to enhance maintainability. See Chapter 10 for verification procedures.

CHAPTER 8

SECTION B

QUALITY ASSURANCE

References:
(a) NHB 5300.4(1B), "Quality Program Provisions for Aeronautical and Space System Contractors"
(b) NHB 5300.4(1C), "Inspection System Provisions for Aeronautical and Space System Materials, Parts, Components and Services"
(c) NMI 8010.1A, "Classification of NASA Payloads"
(d) NHB 5300.4 (2B-2), "Management of Government Quality Assurance Functions for NASA Contracts"

1. PURPOSE

These policies and processes establish the basis for implementing the Quality Assurance (QA) processes necessary for designing, fabricating, delivering and operating major systems. The purpose of these policies and procedures is to reduce mission costs while maintaining acceptable risk, consistent with the type of mission and the complexity and the state of development of available technology.

2. POLICIES

Policies include the following:

a. Applicable related QA requirements in references shall be applied where applicable to NASA system programs/projects.

b. Hardware and software QA activities should be planned and implemented in a timely manner consistent with project schedules. QA planning and assessment should begin before the completion of Phase A in order to support Phase B activities. QA activities should continue during the definition phase (Phase B), as well as during the design, development and test of hardware and software (Phase C/D).

c. System hardware and software designs should be analyzed and validated for operation in all design environments of the system life cycle.

d. Requirements and verification methods should be established to control the design and development processes. Verification methods should be selected that best represent environmental stress on the developed systems without degrading the systems that are tested.

Verification methods also should be selected with due regard to cost and schedule objectives.

e. Problems/nonconformances or failures that occur during design, development, testing or operations should be thoroughly analyzed and corrective action implemented to preclude recurrence.

f. Programs/projects shall perform surveys and analyses of their critical single source production and logistic support suppliers for essential industrial materials, parts, components, systems, and critical facilities. This shall also include consumable, hardware, software and expendable items. The survey results shall be formally documented and made available for Agency use (see section 4 and 6).

Primary responsibilities for plans, implementation and compliance assessment of activities that satisfy QA requirements should be explicitly assigned to both the field installation's project team and to the respective contractors and subcontractors, prior to the issuance of an RFP. These requirements should be extended downward by all hardware and software developers to the subcontractors and suppliers through appropriate contractual documentation.

3. PROCESSES

a. QA Planning:

(1) Assign organizational responsibilities and authority.

(2) Plan the QA effort:

(a) Define quality tasks and their integration within the design, fabrication and test processes.

(b) Provide for the prevention, detection and correction of deficiencies or trends that could result in unsatisfactory quality.

(c) Specifically tailor QA processes to accommodate project resource constraints.

(d) Develop a schedule.

b. QA Implentation:

(1) Identify the QA requirements applicable to designs and procedures.

(2) Train and certify personnel performing hands-on

fabrication, assembly and inspection of flight hardware.

(3) Verify that all design elements are adequately documented.

(4) Verify that all design changes are incorporated into the hardware and software and that the changes are adequately documented.

(5) Witness and monitor tests, taking into consideration the type and criticality of tests.

(6) Perform QA surveillance, inspection and audit of processes that are identified as important to system quality, taking into consideration the nature and the classification of the resulting system.

CHAPTER 8

SECTION C

SAFETY

References: (a) NHB 1700.1B, "NASA Safety Policy and Requirements Document"
(b) NMI 8710.2, "NASA Safety and Health Programs"
(c) NMI 1800.1, "NASA Environmental Health Program"
(d) NMI 1800.4, "NASA Occupational Health Programs"

1. PURPOSE

These policies and processes establish the basis for the implementation of a system safety program to eliminate hazards or reduce the associated risk to an acceptable level.

2. POLICIES

a. The policy for the NASA Safety Program is established by references (a) and (b). For specific health program requirements, policy is established by references (c) and (d). Loss of life, personnel injury/illness, equipment or property damage or loss, mission/test failure, and events that could cause adverse public reaction or environmental damage/loss shall be prevented.

b. System safety programs shall be implemented for system acquisitions, in-house developments, facility design/modifications, and program operations and activities. Program-specific requirements should be based on the advice of the System Safety Steering Committee per NHB 1700.1, Chapter 1. Requirements shall be selected based on the potential for personnel injury, equipment loss or facility damage, property damage, potential impacts to NASA in terms of cost and schedule, and public involvement or interest.

c. Scientific and engineering principles shall be applied during design and development to identify and reduce hazards associated with system assembly, test, operation and support with the objective of designing the safest possible systems consistent with mission requirements and cost effectiveness. System safety and health hazard objectives shall be established in Phase B, and shall be used to guide system safety and health hazard control decisions and activities.

d. Program/project managers shall support and maintain a

well-defined safety program and organization. Safety should be accomplished as an integral part of each manager's and supervisor's responsibilities, with timely monitoring, surveillance and support from the professional safety staff.

3. PROCESSES

a. A System Safety Manager (SSM) should be selected from the field installation organization for Safety, Reliability, Maintainability and Quality Assurance to execute the system safety task. The SSM reports to the project manager for project direction and to the field installation safety official for policy and technical direction. The selected SSM:

(1) Advises the project manager regarding NASA requirements for and status of the system safety task.

(2) Coordinates the system safety effort with systems engineering, reliability and quality assurance, integration and test, and program management.

(3) Identifies necessary technical safety requirements (including those associated with interfacing hardware, software and facilities) and ensures their incorporation into specifications and planning documents.

(4) Ensures that submitted Hazard Reports (HRs) contain sufficient risk management information based on the hazards identified to permit the project manager to make informed risk management decisions.

(5) Reviews system safety tasks, prioritizes safety risks, and recommends engineering, procedural or other changes necessary to reduce the safety risk.

(6) Ensures the implementation of a closed-loop process for providing traceability and tracking of all hazards from identification through resolution. Maintain an up-to-date data base of identified hazards throughout the life of the system.

(7) Assists the project manager in establishing the Project System Safety Panel, as required.

(8) Participates in the FRR and Launch Site Readiness Review (LSRR) process for operations, supporting facilities, and/or flight with the following:

(a) A safety assessment with emphasis on changes to the baseline safety risk; and

(b) A safety certification of readiness with any exceptions arising from safety issues and concerns.

(9) Maintains safety oversight of the project tests, operations, or activities at a level consistent with mishap potential for the life of the system.

(10) Keeps the Office of Safety and Mission Assurance apprised of the status of the system safety tasks, particularly problem areas that may require assistance from Headquarters.

b. A Safety Management Plan (SMP) should be prepared in Phase B to govern the system safety activities throughout the system life cycle. The SMP should be approved by the project manager, and should apply to contractors when approved. The SMP details the specific requirements, tasks, and activities of system safety management and engineering required to identify, evaluate and eliminate or control hazards. It provides a basis for understanding how safety will be applied during all phases of the project. The plan integrates the various system safety activities with major project milestones. The SMP should be reviewed and updated prior to commencing Phases C and E.

c. The total system, including hardware, software, testing, manufacturing, operation, support and disposal of hazardous by-products shall be evaluated for known or potential hazards for the entire system life cycle. Actual and potential hazards and associated risks, including those related to nuclear materials, conventional explosives, propellants and other hazardous materials are identified prior to Phase C.

d. Hazards shall be controlled or eliminated by corrective action with the following priorities:

(1) Eliminate hazardous subsystems within the design;

(2) Minimize or negate the effects of hazards through design techniques;

(3) Install safety devices;

(4) Install caution and warning devices;

(5) Develop administrative controls, including special procedures; and

(6) Provide protective clothing and equipment.

e. The system safety task should create and maintain documentation that provides ready traceability to the baseline safety requirements, criteria and plan throughout the system life cycle. All pertinent details of the hazard analysis and review shall be traceable from the initial identification of the hazard through resolution and any updates, unless it is no longer applicable.

f. Contractors may be required to publish and maintain an implementing safety plan before the startup of operations or commencement of work on deliverable items. The contractor safety plan would be approved by the project safety manager.

g. Project managers shall require formal HRs (see NHB 1700.1, Appendix G) for each hazard with a residual risk to be formally accepted before the SAR. All residual risks shall be formally accepted in writing to close the HR. The process for acceptance of residual risk shall be established in the SMP and shall require critical and catastrophic hazards be accepted at the program manager's level or higher.

CHAPTER 8

SECTION D

ENVIRONMENTAL IMPACT

References:
(a) National Environmental Policy Act (NEPA) of 1969, as amended (40 CFR 1500-1508)
(b) Procedures for Implementing the National Environmental Policy Act, 14 CFR 1216.3
(c) NHB 8800.11, "Implementing the Requirements of the National Environmental Policy Act"
(d) Executive Order 11514, Protection and Enhancement of Environmental Quality, March 5, 1970, as amended by Executive Order 11991, May 24, 1977
(e) Executive Order 12114, Environmental Effects Abroad of Major Federal Actions, January 4, 1979

1. PURPOSE

This section summarizes the policies and processes applicable to NASA officials at NASA Headquarters and field installations concerning their responsibilities under the National Environmental Policy Act (NEPA).

2. POLICIES

NASA Headquarters and field installations shall ensure that actions and decisions that may impact the quality of the environment are environmentally-informed in accordance with the policies and procedures of NEPA. The possible environmental effects of a proposed action shall be considered, along with technical, economic and other factors in the earliest planning, as prescribed in NHB 8800.11. NEPA requirements also apply to NASA-sponsored programs/projects conducted at contractor-owned facilities.

3. PROCESSES

a. Project managers shall be responsible for preparation of analyses to develop an understanding of potential environmental issues and constraints. These analyses should be a clear comparative analysis of impacts among alternatives to enable the project manager to accommodate environmental issues prior to the decision to proceed from Phase A to Phase B.

b. As part of the decision process to initiate Phase C (C/D), program and project managers shall provide any environmental documents required in accordance with

pertinent federal, state, and local regulations. At minimum, an environmental assessment (EA) and/or environmental impact statement (EIS), as appropriate shall be completed and circulated prior to preparation of the Record of Decision (ROD) describing the selection of alternative(s) and the Agency's decision criteria. The ROD is a concise public record explaining the rationale behind the decision.

c. The EA and/or EIS shall include a discussion of all reasonable and practicable alternatives, including the no action alternative, that were considered in the approval decision process along with their respective projected environmental impacts.

d. The PAA is responsible for preparation of the ROD and shall consult with the AA for Management Systems and Facilities prior to release of the decision. Phase C (C/D) contracts can proceed subsequent to release of the ROD.

CHAPTER 8

SECTION E

NUCLEAR SAFETY LAUNCH APPROVAL

References:
(a) Presidential Directive/National Security Council Memorandum-25 (PD/NSC-25), Scientific or Technological Experiments with Possible Large-Scale Adverse Environmental Effects and Launch of Nuclear Systems Into Space, December 14, 1977
(b) NHB 1700.1 (VI-B), "NASA Safety Policy and Requirements Document"
(c) National Aeronautics and Space Council Report, "Nuclear Safety Review and Approval Procedures for Minor Radioactive Sources in Space Operations," June 16, 1970
(d) Nuclear Regulatory Commission (NRC) Rules and Regulations, 10 CFR 0-171

1. PURPOSE

This section summarizes the policies and processes applicable to NASA officials at NASA Headquarters and field installations concerning their responsibilities under the referenced Presidential Directive regarding the launch of certain radiological sources or nuclear systems.

2. POLICIES

a. In the event that any spacecraft carries more than a minor amount of radioactive materials, according to reference (c), or is equipped with nuclear systems, the program/project manager shall:

(1) Provide a safety analysis report identifying the radiological risks;

(2) Proceed through the PD/NSC-25 process to obtain approval from the Executive Office of the President through the Office of Science and Technology Policy (OSTP); and

(3) Take sufficient measures to ensure against an accidental release of radioactive material.

b. In the event that any spacecraft carries a minor amount of radioactive materials, the program manager shall seek approval from the NASA Coordinator for the Interagency Nuclear Safety Review Panel (INSRP) and report this to OSTP, in accordance with reference (b).

c. The program/project manager shall accommodate all relevant NRC requirements for ground activities involving the handling, storage, use, transportation and disposal of radioactive materials prior to launch.

3. PROCESSES

NASA officials shall ensure the performance of the following procedures for missions that warrant PD/NSC-25 launch approval:

a. Project managers shall provide a nuclear safety launch vehicle databook and re-entry analysis as input to the development of a Safety Analysis Report (SAR) on the radiological source or nuclear system. The databook shall contain technical information on the spacecraft, launch vehicle and upper stages, potential launch and on-orbit accident scenarios, the resulting accident environments, locations and their probability of occurrence. Current PD/NSC-25 implementation procedures will require initiating databook development activities at the start of Phase A, Preliminary Analysis. Final databook delivery shall be consistent with DOE's SAR input requirements.

b. The project's SAR will be reviewed by the INSRP. Once INSRP's nuclear launch safety evaluation is completed, its report is presented to the OSTP.

c. The NASA Administrator may then elect to request OSTP nuclear safety launch approval.

CHAPTER 9

TEST AND EVALUATION

References:

(a) NHB 5300.4(1A), "Reliability Program Requirements for Aeronautical and Space System Contractors"
(b) NHB 5300.4(1B-1), "Quality Program Provisions for Aeronautical and Space Systems"
(c) NHB 5300.4(1C), "Inspection System Provisions for Aeronautical and Space Systems Materials, Parts, Components and Services"
(d) NHB 5300.4(1E), "Maintainability Program Requirements for Space Systems"
(e) NHB 5300.4(1F), "Electrical, Electronic, and Electro-mechanical (EEE) Parts Management and Control Requirements for NASA Space Flight Programs"
(f) NHB 5300.4(1G), "NASA Assurance Terms and Definitions"
(g) NHB 1700.1(V1-B), "NASA Safety Policy and Requirements Document"
(h) NHB 5300.4(2B-2), "Management of Government Quality Assurance Functions for NASA Contracts"
(i) NHB 5300.4(3A), "Requirements for Soldered Electrical Connections"
(j) NHB 5300.4(3G), "Requirements for Interconnecting Cables Harnesses and Wiring"
(k) NHB 5300.4(3H), "Requirements for Crimping and Wire Wrap"
(l) NHB 5300.4(3I), "Requirements for Printed Wiring Boards"
(m) NHB 5300.4(3J), "Requirements for Conformal Coating and Staking of Printed Wiring Boards and Electronic Assemblies"
(n) NHB 5300.4(3K), "Design Requirements for Rigid Printed Wiring Boards and Assemblies"
(o) NHB 5300.4(3L), "Requirements for Electrostatic Discharge Control"
(p) NHB 6000.1D, "Requirements for Packaging, Handling, and Transportation for Aeronautical and Space Systems, Equipment and Associated Components"
(q) NSS/GO-1740.9B, "NASA Safety Standard for Lifting Devices and Equipment"
(r) NSTS 1700.7, "Safety Policy and Requirements for Payloads Using the Space Transportation System (STS)"
(s) NMI 8010.1A, "Classification of NASA Payloads"
(t) NASA-STD-2100-91, "NASA Software Documentation Standard"

(u) NASA-DID-A200, "Test Procedures"
(v) NASA-DID-R009, "Minimum Contents for Test Reports"

1. PURPOSE

This chapter establishes policies and processes for verifying that NASA space flight and ground systems meet performance and operational requirements; it includes requirements for verification program content, planning, implementation and assessment. For Class D payloads, as defined in NMI 8010.1A, or non-NASA payloads flown in NASA programs, it is applicable only to the extent required to ensure safety and avoid damage to other NASA systems.

2. POLICIES

a. Space flight systems, together with related flight support equipment, and mission-essential ground support equipment, shall be verified by a combination of test, analysis, and/or inspection to provide assurance that the total system will meet mission performance and operational requirements.

b. Each NASA project shall establish a detailed verification program that includes:

(1) A system verification plan defining the tasks and methods required to determine the ability of the system, including software, to meet each program-level performance requirement and to measure specification compliance. General procedural guidelines are provided in paragraph 3.

(2) Documented procedures and controls to ensure proper planning, implementation, assessment, configuration management, quality assurance and independent review of verification activities.

(3) Timely identification and assessment of program risk due to limitations in verification capabilities.

(4) Requirements for documenting and archiving all verification procedures, results, supporting analyses, deviations and waivers in sufficient detail to support independent review and audits.

c. Testing is the preferred form of verification for NASA space systems and shall consist of qualification and acceptance tests.

d. Test requirements shall be traceable to mission requirements and system specifications and shall be

tailored to reflect system design complexity, mission criticality, cost and risk. Simulations must be verified to accurately model the instrument in which the system will operate.

e. Test programs shall, to the extent practical, simulate all significant environments and demonstrate the ability of the system to satisfy performance requirements in all planned operating modes. Test programs shall include end-to-end testing of the system, including appropriate simulation or emulation of interfaces.

f. Where realistic simulation of natural and induced environments is limited by physical or economic constraints, these limits and their effects on risk shall be identified in the verification plan. Augmenting analysis and/or supplemental testing shall be performed to demonstrate that performance requirements can be met within the limits of acceptable risk.

g. Where analysis is used in place of or to supplement testing, the analytical models shall be validated by corroborative testing or by correlation with independently derived models. Design factors of safety should be increased to allow for increased uncertainty.

h. Qualification testing shall be conducted to demonstrate that design and manufacturing specifications have been met and that the resulting system (hardware and software) will meet performance requirements with adequate margins. Qualification testing shall impose load and environmental stresses that exceed the worse-case values expected to occur during the complete life cycle, including storage, transportation, and handling. Life tests and analyses shall be performed on limited life and critical components.

i. Systems that have been tested to qualification levels and duration (prototype test) shall not be used for flight without certification and, where necessary, refurbishment and acceptance testing.

j. Qualification by similarity may be used in lieu of testing. Differences from previously qualified systems/system elements must be qualified by supplementary tests and analyses.

k. Acceptance testing shall be conducted to demonstrate satisfactory performance of flight systems in the expected environment for all flight operational conditions and functions, including redundancy, and to reveal inadequacies in workmanship and material integrity.

l. Protoflight systems shall be tested to qualification levels for acceptance duration.

m. Software verification and validation should be integrated with flight hardware system verification to the maximum extent practical. The system verification (both hardware and software) shall be covered in the Verification and Validation (V&V) Plan to include the activities, methods and degree of independence. (Ref. NASA-DID-M400). Independent V&V shall be considered and the program decision to exercise shall be documented in a program assurance plan for V&V.

n. Flight support equipment shall be verified to the same qualification and acceptance requirements as flight hardware. Mission-essential ground support equipment, including ground test facilities, shall be verified to ensure that interfaces, environments, and operations meet program requirements and do not compromise the integrity, performance or life of the flight system.

o. All configuration changes and/or repairs made subsequent to qualification or acceptance testing shall require a formal systems engineering impact assessment. Functions potentially affected by changes/repairs shall be reverified by the same process initially used.

3. PROCESSES

a. General. This section establishes procedural guidelines for test programs intended to reduce the risk of hardware and software failures which may arise from deficiencies in hardware design, assembly, fabrication, manufacture, rework/repair, and materials, or software design, coding, integration or other essentials. The objective is to provide program guidance and methodology for structuring and administering test verification programs to ensure successful operation of NASA aeronautical, space and ground systems.

(1) NASA project managers shall ensure the guidelines are addressed when formulating their test verification program(s). Test requirements shall be identified in the contract/subcontract and/or the task assignments between project offices/agencies. It is intended that these guidelines be tailored/modified to the specific program or project, flight or flight-related hardware and software, considering design complexity, state-of-the-art, mission criticality and acceptable risk.

(2) Questions concerning application of this publication to specific procurements shall be referred to the NASA project office or its designated representative.

b. Test Planning

(1) The general nature and scope of test programs shall be structured from the beginning to meet the objectives of the various life cycle phases beginning with design and development. Because some requirements may be verifiable by means other than tests (i.e., analysis, simulation, pre-existing data), the overall requirements should be identified by a systematic examination of all applicable verification methods. The ability of tests at various levels to provide meaningful verification data shall be evaluated. The test program to be implemented should be that which:

(a) Most effectively verifies the requirements are met, and

(b) Does not degrade the developed item.

(2) The test program shall provide for the proper planning, integration, and implementation of the basic program test activities, including design qualification testing, equipment/software acceptance testing, and flight/operational testing under specified environmental conditions. Preliminary planning for integrated testing during all phases of design, development, production, and operations shall be accomplished as early as possible.

(3) A verification matrix shall be used to relate requirements to system architecture and to tests to be used to verify requirements. Reviews shall be conducted to detect overlaps, voids, or redundancies, and to make initial project decisions to combine, add or eliminate unnecessary tests. The test milestone chart is used to present the relationship of all tests and to assess the dependencies of the test program when test slippage and test facility downtime occurs and tests must be rescheduled, or when tests must be added.

c. Master Test Plan. This plan shall provide a detailed outline of the entire spectrum of test activities associated with a NASA system. It should state the test concepts; the objectives/requirements to be satisfied; test equipment safeguards; the methods, elements, and responsible organizations associated with the accomplishment; identify the resources required; and index other subordinate documents and plans used to implement and record the results of the test effort. The plan shall contain the supporting/lower-tier test plans, procedures, and schedules necessary to define and control the total test program. The plan should present all the test actions/activities associated with the program, from design and development to operational use,

and their relationship in time, content and responsibility. The software test planning shall be documented (NASA-DID-M400) and be an integral part of the Master Test Plan. The Master Test Plan should address the following subjects:

(1) Test Types,

(2) Schedules/Flow Diagrams/Milestones,

(3) Support Requirements,

(4) Documentation, and

(5) Management Information System.

d. Specific Test Plans. Test plans shall be required for each system, subsystem, assembly, item of hardware, firmware and software that is to be tested. These plans should cover every level of testing on systems, equipment, firmware or software. Each plan should provide the test concept, objectives, and requirements to be satisfied, test methods, elements, responsible activities associated with the test, measures required and recording procedures to be used. Test plans (both hardware and software) shall include a test compliance matrix to map the test elements to the appropriate system and sub-system specification. Each test plan shall be a subset of the Master Test Plan. As a minimum, each test plan should normally include the following:

(1) Title Page.

(2) Introduction: Overview of objectives of the test plan, including flow diagrams, milestones, personnel participation, locations, environments, schedules and security requirements to be observed.

(3) Flow Diagrams: The flow diagram should present a functional description of the test program using a block diagram portrayal of the functions and sequence that must be met to satisfy the total test program.

(4) Participation: Identifies the NASA, Government and contract participation roles and responsibilities.

(5) Location: Identifies the facilities where the testing shall be performed.

(6) Security: Identifies and states, briefly, any security measures or guidelines to be observed.

(7) Master Test List: List of all tests to be performed in the order they are to be performed. Each listing should include:

(a) Test Description. Name and brief description of test to be performed.

(b) Applicable Specification(s).

(c) Test Objectives. Objective of each test performed, including the success/failure criteria, baseline, duration, and number of times each test shall be performed.

(d) Nonconformance/Failure Reporting. System, procedure, documentation for the reporting of failures and rejection of material/items.

(e) Test Equipment. List all equipment and tools to be used in the test.

(f) Instrumentation. Indicates the type and recording devices to be used and the number and types of parameters to be recorded.

(g) Data Reduction and Analysis. Describes data to be recorded and the data reduction and analysis techniques to be used to interpret the data.

(h) Government/NASA Test Facilities. Identifies applicable facilities and includes a reference to the appropriate facility requirements documents.

(8) Environmental Exposure: Test plan should specify the environmental exposure that the hardware will be subjected to during this test.

(9) Validation Procedure: Overview of the procedures that NASA or the contractor shall use to validate the test results.

e. Test Procedures. A test procedure shall be prepared for each test to serve as a step-by-step guide for the test personnel who shall perform the test and to enable others to monitor conduct of the test. It shall identify the testing operations to be performed on items undergoing developmental, qualification or acceptance testing. It identifies items to be tested, the test equipment and support required, the test conditions to be imposed, the parameters to be measured, and the pass/fail criteria to include the tolerances against which the test results shall be measured. Necessary

test equipment and instruments are specified, the test set-up is shown schematically, all required measurements and tolerances are listed. Data sheets used to record results/item performance in the test are included as part of the procedure. Appropriate safety warnings and back-out criteria, if necessary, are also included in the test plans. The test procedure should contain the following:

(1) Cover and Title Page.

(2) Record of Changes. Provides for tracking of approved changes to the test procedure.

(3) Table of Contents.

(4) Applicable Documents. Documents necessary to fully develop the test procedure should be listed by title, number, date, and source.

(5) Purpose of Test.

(6) Test Equipment Identification.

(7) Any special Support Requirements.

(8) Step-by-Step Procedure, including:

(a) Test set-up diagrams, including interconnection of test equipment and test article;

(b) Mounting instructions (type of mounting hardware and torque values);

(c) Location of measuring or coupling devices (e.g., transducers);

(d) Input and output instrumentation points;

(e) Test item operating limits and test conditions (e.g., temperature, humidity, cleanliness requirements);

(f) Performance parameters to be measured;

(g) Identification of data to be recorded and characteristics to be inspected;

(h) Step-by-step operations/sequence of testing to obtain the required data;

(i) Identification of steps to be verified before proceeding;

(j) Assignment of mandatory/hold inspection points;

(k) Details of required or optional nondestructive evaluations (x-ray, dye k, visual inspections, proof tests, etc.);

(l) Nonconformances or anomalies (instructions for handling);

(m) Procedure deviations (instructions for handling);

(n) Sampling procedure details for selection (if required by specification or plan);

(o) Caution and safety warnings as appropriate.

(9) Data Sheets. Data sheets shall be included with the test procedure or separately attached at the end of the procedure.

For further guidance on test procedures refer to NASA-DID-200, "Test Procedures".

f. Test Records and Data. Each project office/contractor shall prepare, maintain and update the records for each item, hardware and software, as a means of documenting its continuous history. Each record should be identifiable to the pertinent item and shall be maintained in chronological order.

(1) Hardware: Hardware records shall account for all fabrication, assembly, adjustments, modifications, inspection and test operations, as well as idle periods (storage) and movement. Entries shall be complete, self-explanatory, and signed, and shall include or refer to details such as the following:

(a) As-Designed Configuration Data: Baseline configuration plus approved changes and deviations.

(b) As-built Configuration Data: Parts list, drawings, specifications, changes, waivers, deviations and identification data.

(c) Fabrication and Assembly History: Build-up and disassembly instructions, repairs, rework, adjustments and modifications.

(d) Inspection and Test Records: Specifications, procedures, results and variables data.

(e) Nonconformance Summary: Initial review, Material Review Board actions, deviations and waivers, including appropriate contracting officer approvals.

(f) Cumulative Operating Times or Cycles: Data derived from test and maintenance logbooks.

(2) Software: Software records shall account for all functional analyses and modeling, software development/test tool selection analyses/ demonstration, software design analyses, design, coding, integration, modifications (patches, patch logs, etc.) inspection and test operations, as well as support software, processor, and peripheral equipment requirements and set-up. Software records shall be documented in accordance with the Assurance and Test Procedures Data Item Description found in the Software Documentation Standard NASA-STD-2100-91, NASA-DID-A000 section 4.0. The records shall contain but are not limited to: V&V objectives, procedures and activities. Entries shall be complete, self-explanatory, and signed, and shall include or refer to details such as the following:

(a) As-Designed Configuration: Baseline configuration plus approved changes and deviations.

(b) As-Built Configuration Data: Version Description Document, drawings, specifications, changes, waivers, deviations and identification data.

(c) Development and Coding History: Compilation system demonstrations, development tool demonstrations, firmware design/validation, code analysis, error reduction, development testing, and error tracking, rework/recode, adjustments and modifications. Software documentation verification.

(d) Inspection and Test Records: Specifications, procedures for each level of testing, procedures for software documentation validation, software tools and simulations, results and variables data.

(e) Nonconformance Summary: Initial review/error analyses, software review actions, deviations, and waivers, including appropriate contracting officer approvals.

(f) Cumulative Operating Times or Cycles: Data derived from simulation/test equipment setup and software operating logs and maintenance logbooks.

g. Test Reports. The test report documents the results of a test performed on a system, subsystem, equipment, or component, the findings, and the analysis performed to determine achievement of the design, developmental, fabrication, acceptance, quality conformance or environmental performance objectives specified in related specifications, standards, or contract work statements. The report describes the test performed and is used to document compliance. All tests shall be documented by test reports within a few weeks of completion. Tests stretching over several months shall be reported at intervals. The content of the report shall be tailored consistent with the testing requirements and the program phase. The test report should normally contain this information:

(1) Cover and Title Page

(2) Table of Contents

(3) Purpose of Test

(4) Complete Identification of Item Tested/Inspected

(5) Summary

(a) Discussion of significant test results, problems encountered, observations, conclusions and recommendations,

(b) Proposed corrective actions and schedules,

(c) Identification of deviations, departures or limitations encountered,

(d) Tables, graphs, illustrations or charts to simplify summary data.

(6) Authentication

(a) Authentication of Test Results: Statement that test/inspection was performed on a properly configured hardware/software in accordance with applicable specifications, test/inspection plans, and procedures, and that results are true and accurate. Statement shall be signed by tester/inspector and witnesses as authorized.

(b) Authorization of Acceptability: Statement that the item tested/inspected passed or failed item acceptability requirements. Statement shall be signed by authorized personnel witnesses.

For further guidance on test reports refer to NASA-STD-2100-91 and NASA-DID-R009.

h. Quality Actions. The project office/contractor shall assure that all aspects of the test program are adequately planned, including requirements for surveillance and inspection, and that vendor equipment, facilities, and documentation necessary to perform the test are available to support testing.

(1) Prior to testing, the project office/contractor's quality program personnel shall verify:

(a) The applicable inspection and current approved test documents are available.

(b) The hardware and software are identified.

(c) The hardware and software conform to the configuration specified in the test procedure.

(d) The test equipment is calibrated and such calibration will be effective and sustained during the test period. Production tooling should not be used for inspection acceptance unless it can be verified, controlled and calibrated to the extent necessary to ensure the required accuracy and ready detection of deficiencies.

(e) The test readiness status of the article to be tested, i.e., inspection history, documentation, condition of equipment, open nonconformances.

(f) The test set up is in conformance with the approved test procedure prior to start of the test.

(g) The test facility complies with requirements established by the test procedure, including temperature and/or humidity controls, contamination controls and electrostatic discharge controls.

(h) That all safety requirements have been met.

(i) The tooling and/or fixtures required for the test have been validated.

(j) The personnel are available and have required certifications.

(k) The configuration of any computer software used with the test or embedded into the test item for the test.

(2) During testing, the project office/contractor's quality program personnel shall:

(a) Ensure that testing is accomplished in accordance with approved test specifications and procedures.

(b) Ensure accurate and complete recording of data and test results.

(c) Document rework, adjustment, repair or modifications to the hardware or software occurring during the test operation.

(d) Document all changes to test procedures.

(e) Ensure that only approved changes are incorporated into the test procedures.

(f) Document nonconformances.

(g) Ensure that any retest is accomplished in accordance with NHB 5300.4(1B-1), paragraph 1B703.

(h) Ensure that personnel and equipment safety constraints are observed.

(i) Document any discrepancies with test support equipment and testing environments.

(3) Subsequent to testing, the project office/ contractor's quality program personnel shall:

(a) Ensure proper disposition of hardware and software.

(b) Report any additional nonconformances.

(c) Ensure that corrective actions have been accomplished relative to nonconformances.

(d) Verify that test results and reports are accurate, complete and traceable to the tested

hardware and software.

(e) Perform a post-test inspection to identify any changes to the article that may have developed as a result of the test.

(f) Ensure approved changes have been incorporated into the test procedures/specifications.

For further guidance refer to NHB 5300.4(1B-1).

CHAPTER 10

MISSION OPERATIONS

Reference: (a) NMI 8430.1C, "Obtaining Use of Office of Space Communications (OSC) Capabilities for Space, Suborbital and Aeronautical Missions"

1. PURPOSE

This chapter provides implementing policies and processes applicable to a wide range of flight programs and projects. Mission operations include the definition, development and operation of ground systems to train personnel, conduct flight missions and to process, analyze, distribute and archive data received from flight missions. Flight missions include free flying spacecraft, aircraft and payloads.

2. POLICIES

a. Program/project planning at every phase will reflect the operational aspects of the mission. Milestone decisions will consider the quality and specificity of operations planning, consistent with the maturity of the system.

b. Operations requirements (flight vehicle and ground system) will be developed and established early in the project life cycle, and assessed at the SRR. Issues arising between operations and development organizations regarding implementation of requirements will be settled in a timely manner by the next higher level of management above both organizations.

c. Operations capability will be designed, developed, implemented and maintained in a disciplined way resulting in qualified systems, procedures, and operations personnel to meet mission requirements.

d. Personnel training and certification processes shall be developed and executed so that planned and contingency operations will be conducted safely.

e. Operations will not be initiated until test and simulations establish that the system, personnel and procedures are ready to support operations.

f. Operations reviews will be conducted to demonstrate readiness for transition to critical operations.

g. Mission operations will be defined by clear lines of authority and accountability, rigorous security and

access controls, and thorough record-keeping.

3. PROCESSES

a. Operations Concept. An operations concept for the mission must be developed. The operations concept must address the following:

- How the entire system works-end-to-end,
- Users and how they use the system,
- Functions performed by the spacecraft/instruments,
- Functions performed by the ground system and the products it creates,
- Functions performed by the operators,
- Roles and interface of the various ground elements versus the onboard systems/flight crew:
  -- Before a mission/observation/experiment,
  -- During the mission/observation/experiment, and
  -- After the mission/observation/experiment,
- Communications services linking the ground and flight systems elements,
- Method and timeliness of data processing and distribution,
- Arrangements for data analysis and archiving,
- For flights involving human crew, identification of the functions to be performed by each member,
- Human versus automated operations, and
- Safety and quality assurance.

b. Operations Development.

(1) Operations systems are developed based on analysis of mission objectives and user requirements, as well as the operations system's functional, performance, interface, verification and operations support requirements. These analyses should include development of operational scenarios to reveal the essential functions and inter-relationships among system elements in the course of carrying out flight operations. The requirements to be placed on the flight project, launch vehicle, etc., should be reviewed in the SRR, Chapter 2.

(2) The results of operations development will include the following documentation and will encompass all components that comprise the operations system.

(a) Operations System Specification - This document contains the technical and

performance requirements for the system, verification requirements and operations requirements. The specification represents a technical agreement between the operations system developer and project manager. It also establishes the basis for judging the technical acceptability of the developed system.

(b) Ground System Implementation Plans - These plans typically include a management plan that includes the implementation schedule, a detailed time phased cost estimate with contingency, and a risk management plan. The plans should also include an operations test and simulation plan for the end-to-end system, post delivery support, a product assurance plan, configuration management and data management.

(c) Operations Plans - Operations plans will be developed to define the operations phases (pre-launch, launch transition, activation and checkout, and mature operations) and the participating organizations. These plans should include an organization and staffing plan for operations, including the skill level of each position. These plans should also include plans for training and maintenance and a schedule of the operations activities.

(d) Operations Procedures - The full complement of operations procedures needed for normal operations, as well as procedures for deployment, activation of backup systems and safemode recovery will be documented.

c. Operations Staff Training and Certification. This training and certification, including that for astronauts, will be performed in accordance with the following:

(1) Training and certification requirements must be defined early and factored into the program plan. This includes definition of requirements for training tools and their integration with requirements for related tools, such as simulators for ground test and simulation, flight software test beds, et. al., to avoid redundant efforts.

(2) A formal premission training and certification program will be defined for each flight crew member and operations position. Integration, test, and simulations should be coordinated in order to avoid

redundant efforts.

(3) Certification tests shall be developed and used to validate the application of knowledge in real-time judgmental situations.

(4) Training shall include nominal and appropriate contingency operations.

(5) A post launch regressive training program shall be established to ensure continued maintenance of adequate technical competencies, and to stay abreast of mission changes.

d. Operations Test and Simulations.

(1) Operations tests and simulations will be conducted as an iterative process that starts with tests at the component level and builds to end-to-end mission simulations that verify the readiness of the systems, personnel and procedures to support operations. Tests and simulations will begin early enough to enable correction of problem areas that must be resolved prior to initiation of operations. Sufficiant test and simulation will be conducted to allow the project to enter actual flight operations with a certified capability and a full understanding of any constraints.

(2) The test process must be tailored for each project. Factors to be considered in tailoring the test process include use of institutional systems, complexity of mission operations, number of interfaces in the end-to-end system, and the risk class of the project/program.

(3) Testing starts with interface testing and includes compatibility testing, end-to-end testing, mission profile testing and mission simulations as follows:

(a) Interface Tests. These tests validate that the elements of the end-to-end data system have been implemented to the negotiated interface requirements. These tests verify that the formats and protocols are correct. Test data generators are typically used for these tests, although simulated or recorded spacecraft data sets can be used.

(b) Network Compatibility Tests. These tests ensures that the spacecraft is compliant with the radio frequency interface of the supporting networks. The network provides the required test tools (e.g., the Compatibility

Test Van for the Space Network).

(c) Mission Compatibility Tests. These tests are performed to ensure that the mission operations center can correctly command and monitor the spacecraft. These tests include the interaction of the mission operations center with the spacecraft, usually during spacecraft integration and test. Other components of the operational end-to-end system should be included in these tests if possible.

(d) End-to-End Tests. These tests exercise the complete communication path between the spacecraft and the operational ground systems. These tests exercise the interfaces of the ground system simultaneously.

(e) Mission Profile Tests. These tests exercise all elements of the operational ground system with emphasis on data processing and interface functions. For this purpose, these tests use realistic mission time dynamics in amounts of data and the sequencing of events. Simulators and recorded spacecraft data are typically used to drive these tests.

(f) Mission Simulations. These simulations are the final exercises prior to launch and demonstrate that the personnel and procedures as well as the data systems are in place and complete. Mission simulations exercise typical operations as well as critical phases of the mission, such as launch, deployment and activation. Anomalies should be introduced to evaluate personnel readiness and procedures. Mission simulations typically use a simulator and are augmented by the spacecraft and/or recorded spacecraft data.

e. Operations Reviews.

(1) Prior to entering Phase E, there are a number of operations reviews conducted to ensure that the mission is ready to enter Phase E.

(a) Ground System Review. This review is conducted during Phase D to determine that Phase D activity is proceeding as planned and that the project will be ready to enter Phase E on schedule. The review should cover the entire ground system (from the receiving elements to the end user) and include the

ground system status, test plans and ground system issues. This review is conducted early enough to allow for corrective actions and in time to supply prerequisite information for a launch minus two year MR as described in Chapter 2.

(b) Mission Operations Review. This review covers the detailed plan on how the project will prepare for launch, and conduct the initial activation and transition to normal operations. The review should include schedules, staffing, operations procedure development (including contingency procedures), training and certification, end-to-end tests and mission simulations, and any operations issues. This review is conducted early enough to allow for management corrective actions and in time to supply prerequisite information for a launch minus one year MR as described in Chapter 2.

(c) Pre-Ship Review. This reveiw is conducted at the end of the spacecraft integration and test phase to verify that the spacecraft is ready to be shipped to the launch site.

(d) Launch Site Readiness Review (LSRR). The LSRR is conducted to verify readiness of the launch site equipment, facilities and personnel to begin pre-launch operations. The review is held at the same time as the Pre-Ship Review.

(e) Flight Operations Readiness Review. This review is conducted to determine the readiness of the end-to-end system and its personnel to support launch and operations. This review should address the results of testing to date, any discrepancies or workarounds required to support launch and operations, and the status of the operations staff and their training. The intent of this review is to identify problems in time to fix them without holding launch.

(f) Flight Readiness Review (FRR). For crewed missions, an FRR will be held approximately two weeks before launch. This review is the management decision to proceed with launch. It includes a detailed discussion of the operations timeline and procedures provided by the mission operations element, including contingency procedures. Any discrepancies in the testing of the elements of the end-to-end

systems or in the training and certification of operations personnel is identified and workarounds are presented. At the conclusion of the FRR, the Certification of Flight Readiness (COFR) is signed by the NASA and contractor project managers, SR&QA managers, and the Space Shuttle Director of Operations.

(g) L-2 Day Review. This review is conducted at launch minus two (L-2) days to certify flight readiness. The L-2 Day Review certifies that all open work remaining at the conclusion of the FRR, action items assigned at the FRR, and any problems that develop following the FRR have been satisfactorily accomplished and closed out and that the mission can be conducted safely. A COFR document, similar to the one signed at the FRR, is signed at the conclusion of the L-2 review.

(h) L-1 Day Review. This review is conducted at launch minus one day to close out any open work resulting from the L-2 Day Review and any problems that develop following the L-2 Day Review. Launch day weather assessments are an important part of the L-1 Day Review prior to final tanking weather assessment.

(2) The operations reviews for a project must be tailored for that project. Factors influencing the timing and formality of the reviews include the type of critical operations transition, the complexity of the operations, the number of elements in the end-to-end system, and the heritage of the elements and personnel supporting the project.

f. Operations.

(1) A clear line of authority and accountability shall be established for the conduct of mission operations. An official shall be designated to which all operations personnel report. This official will approve the initiation of operations activities, and deviations or changes to established procedures, and will normally supervise critical operations, such as the recovery from a spacecraft safe mode.

(2) The duties, responsibilities and authorities of every member of the operations team must be written and understood by all. A well disciplined operations organization will properly resist informal requests by unauthorized persons,

regardless of their rank, to take actions involving the spacecraft, flight crew or ground systems.

(3) Access to operations control rooms and facilities shall be limited to authorized members of the operations team. Appropriate physical security shall be employed at facilities that are directly in-line with the conduct of mission operations. Appropriate electronic security shall also be provided to prevent unauthorized persons from interfering (by way of telecommunications) with systems used in the conduct of mission operations.

(4) Detailed planning of pre-launch and non-routine on-orbit operations is required. Three distinct phases are usually encountered:

(a) Prelaunch, launch, deployment, rendezvous/docking/undocking, and deorbit - characterized by time critical activities and activation of subsystems for the first time. These operations may require the presence of subsystem experts (designers) in the control room.

(b) Post-launch activation and checkout - these operations are less time critical but may differ considerably from routine operations. They may involve a detailed characterization of the performance of subsystems and instruments.

(c) Routine operations - those that are performed over the course of the mission and do not involve safety or complex/time critical actions.

Each of these three phases requires planning as necessary to ensure the success of the mission. In particular, the time critical operations deserve the most attention.

(5) Records of operations shall be kept as a means for later determining what might have gone wrong in the event of an anomaly. The records shall consist of a log book with entries made by the real-time operators on duty, plus electronically created and stored records of all commands sent to the spacecraft, instructions entered by operators into the ground systems, and telemetry data received from the spacecraft, all tagged by day and time of day.

(6) In missions involving human flight crew, audio

recordings of all voice communications shall be kept. For launch and critical flight operations, audio recordings of voice communications among ground based operators also should be made.

(7) A system of documenting anomalies shall be maintained to ensure that each anomaly is appropriately analyzed and the most likely cause is determined. An anomaly is any unexpected action of the spacecraft, flight crew, ground system, or an operator that may indicate a failure of some element of the system. The anomaly reports constitute the cumulative experience of what has changed or been learned over the course of mission operations, and is a vital resource in coping with future anomalies.

(8) Policies on data archival and the rights to data need to be well known among the flight crew and operations team and procedures established to ensure that the provisions are respected.

CHAPTER 11

PROGRAM MANAGEMENT COUNCIL

The PMC is the primary Agency-level forum for addressing planning, implementation and management of all major Agency programs and projects. The PMC is supported by:

(1) Ad hoc teams of independent experts who conduct independent reviews and provide ICE's in support of PMC planning and implementation oversight responsibilities; and

(2) A PPMSG which provides the PMC a mechanism for working management policy, process and related issues.

The PMC reviews and corresponding documentation requirements are depicted in Figure 11-1 in terms of the project life cycle. The following sections, organized as indicated below, describe each of the reviews and establish the detailed policies and processes governing Agency-level program/project approval and review.

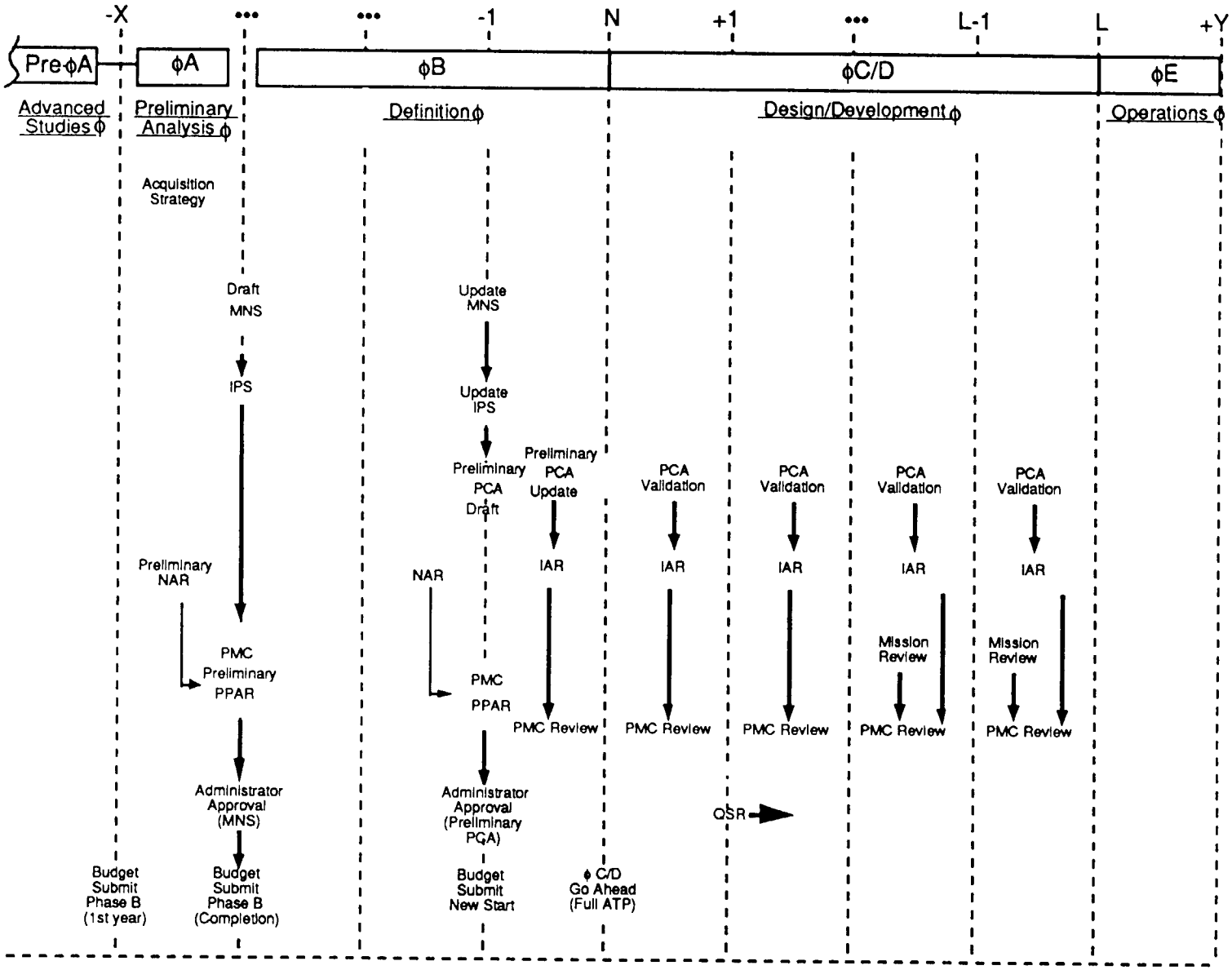

Figure 11-1. PMC Documentation Requirements and Reviews as Related to Life Cycle for Major NASA Projects (by Fiscal Year)

CHAPTER 11

SECTION A

PROGRAM MANAGEMENT COUNCIL REVIEWS

1. PURPOSE

This section defines the reviews conducted by or reported through the PMC in support of Agency-level approval and oversight of programs and projects.

2. POLICIES

a. The PMC shall utilize a formal review process to ensure that all programs/projects considered for approval meet and fulfill the following decision and management criteria, respectively:

(1) The mission need is consistent with Agency strategic planning;

(2) The program and project plans are in accordance with NMI 7120.4 and NHB 7120.5;

(3) Commercial technology development opportunities are maximized;

(4) The projected cost, schedule, performance, objectives and deliverables are reasonable, and a clear baseline interweaving these elements is committed to by all responsible authorities, before final authority to initiate Phase C or C/D;

(5) Program/project risks and issues are defined and updated prior to initiating Phase B or C, respectively, and a Risk Management Plan is developed in the early stages of a program/project;

(6) Affordability within the projected Agency budget is realistically and favorably projected prior to recommending authority to proceed with Phase B and subsequent phases.

b. The PMC shall maintain significant oversight throughout the life of major programs/projects to ensure conformance with PCAs.

c. The PMC will prudently exercise authority for special or cancellation reviews, as necessary, when unforeseen issues arise or thresholds are projected to be exceeded.

3. REVIEW REQUIREMENTS

The PMC review requirements are summarized in Table 11-A-1 and described below in terms of two categories: reviews conducted by the PMC itself, and reviews conducted by other groups to provide the PMC with various independent assessments of programs and projects.

CHARACTERISTICS	**TYPES**				
Subject	**Major Programs**				**Major Contracts**
Type	**Decision**	**Validation**		**Status**	**Metrics**
Title	PPAR	IAR	MR	QSR	Contractor Metrics
Purpose	Independent, in-depth evaluation of readiness to proceed	Independent assessment of cost/schedule/ performance against PCA (baseline)	Independent assessment of launch/mission readiness	Cost/schedule/ performance status report	Contractor performance measurement report
Frequency or Timing	Preliminary PPAR Phase B readiness PPAR Phase C/D readiness Cancellation As needed	Annually	L-2 Year L-1 Year	Quarterly	Quarterly
Responsibility for Preparation/ Presentation	PAA and NAR Team	CFO Appointed Independent Team	PAA Appointed Independent Team	PAA	Office of Procurement AA
Outcome or Product for Administrator	Recommendation for proceeding or cancellation	PCA validation or recommendation for change	Validation of launch/mission readiness or recommenda-tions regarding delay	Assessment of adherence to baseline, issues identification	Issues identifica-tion, recommendation of major contracts

Table 11-A-1 PMC Review Types and Characteristics

a. Reviews Conducted by PMC

(1) Preliminary Program/Project Approval Reviews (Preliminary PPAR's). Upon PMC Chairperson approval of a request by the cognizant PAA, the PMC shall meet to review a candidate program/project's readiness to proceed to Phase B. The PMC shall determine that all Phase A requirements have been satisfactorily met. The review will include the

results of the Preliminary NAR and ICE efforts, and will culminate in readiness recommendations to the Administrator.

(2) Program/Project Approval Reviews (PPAR's). Upon PMC Chairperson approval of a request by the cognizant PAA, the PMC shall meet to determine that the program/project's readiness to proceed to Phase C or C/D. The PMC shall determine that all Phase B requirements have been satisfactorily met. The review will include the results of the NAR and corresponding ICE efforts and will culminate in readiness recommendations to the Administrator. When full rate production of multiple units is required, initiation of Phase D shall require an additional PMC review and the Administrator's approval to proceed, according to this same procedure.

(3) Major Technology and Advanced Development Reviews. The Council will review, assess and make recommendations regarding major technology and advanced development programs. Emphasis will be given to commercial benefits after considering future mission need, potential for multi-mission or multi-program use, potential return on investment (in terms of both cost and performance) for both Agency and commercial use, readiness to begin the proposed phase of R&T development, and the realism of the funding profile.

(4) PCA Validation Reviews. Prior to Phase E, the PMC shall annually review a written validation prepared by the cognizant PAA concerning program/project conformance to the current PCA. The PMC will utilize the results of an independent review of the PCA validation primarily to ensure adherence to the program/project threshold requirements (see section 3.b.(2)(a)). The PMC will recommend any changes to the PCA or program plans as a result of the validation process. The PMC will annually determine the need for PCA validation during Phase E.

(5) Quarterly Status Reviews (QSR's). The PMC will meet quarterly to review program/project status. These reviews are to focus on performance, cost and schedule, as measured against the program's baseline plan. In addition, emergent issues and concerns should be highlighted. The overall objective of the QSR is to answer the question, "Is the program 'on track' or, is it heading for trouble?" Responses are a key determinant in the

need for special reviews of individual programs/projects requested by the PMC.

(6) Contractor Metrics Reviews. The PMC shall meet as necessary to review the results of contractor metrics reporting relative to major contracts. Those reviews should result in:

(a) Identification of issues for consideration by the Administrator based on individual contractor metrics reports;

(b) Recommendations of the top contracts to be reported; and

(c) Identification and resolution of issues affecting overall program/project policy.

(7) Special Program/Project Reviews (SPPR's). The PMC may hold SPPR's when warranted.

(a) Special program/project reviews may include, but not be limited to, reviews for recommending cancellation or continuation of programs and projects, as required, whenever a threshold established in the PCA is projected to be violated or whenever the PAA or CFO/Comptroller projects that the program/project EAC exceeds the baseline PCC or DCC component of the PCA by more than 15%. The QSR, annual PCA validation process, and changes to Agency strategic planning will be key determinants on the need for these reviews. Topics to be covered in an SPPR shall, to the extent possible, be identified at least 30 calendar days prior to the scheduled review, unless a shorter period of time is authorized by the Administrator for the specific review in question.

(b) Documentation required for an SPPR shall be tailored to the specific requirements of the PMC and shall in no case exceed the requirements for a PPAR without specific authorization of the Deputy Administrator.

b. Independent Reviews Conducted for the PMC

Independent reviews provide the PMC with independent assessments of programs/projects to support a variety of decisions. Specifically, independent reviews will be conducted as follows:

(1) NAR's During the Program/Project (Phases A and B). A NAR provides an independent assessment of a program/project's readiness to proceed to the next program phase. The findings, issues, concerns and recommendations of the Preliminary NAR and NAR Reports will be used to support PMC deliberations and Administrator decisions on a program/project's entry into Phase B and Phase C/D, respectively.

(2) Independent Reviews During Project Implementation (Phases C, D and E).

(a) Independent Annual Reviews (IAR's). The PMC process to validate the PCA (see section 3.a.(4)) includes an IAR chartered by the CFO/Comptroller conducted to assure compliance to the PCA defined thresholds. An IAR is required during those years when a NAR is not conducted. This independent review is not as detailed as a NAR, and generally will require a smaller technical team to achieve the objective. The CFO/Comptroller will be responsible for briefing the results of the IAR to the PMC.

(b) Special Program/Project Support Reviews. The PMC will charter special teams to support the Special Program/Project Reviews conducted by the PMC (see section 3.a.(7)).

(c) Mission Reviews (MRs). These reviews focus on the pre-launch, launch and operations phases of a program/project (see section 3.(f) of Chapter 10). MRs are conducted at about two years and one year prior to launch. The cognizant PAA appoints the MR chairperson who is responsible for identifying a relevant group of independent experts to conduct the review. The MR reports are included in the appropriate QSR's.

(d) Other (NAR's). Upon the direction of the PMC Chairperson, other full scale NARs may be held for special purposes, such as to develop recommendations for the Administrator on decisions other than those described above (e.g., change in mission objectives, violation of commitments in PCA, acquisition strategy change, etc.)

4. REVIEW SCHEDULING

a. Agency planning, the annual Agency budget development cycle, and decisions to proceed with major programs are necessarily linked at critical times in the fiscal year. A nominal timeline for critical scheduling of these processes, as it relates to scheduling of PMC reviews, is shown in Figure 11-A-1. The focus of this figure is on the relationship of various elements of the review process and not on actual dates. It is the responsibility of the cognizant PAA to assure timely requests for either a Preliminary NAR or NAR to support PMC reviews and special meetings linked to the Agency budget cycle.

b. Prior to the start of the annual budget cycle, the PMC will meet to collectively view all new Phase A efforts early in their life and provide guidance to the PAA's on the Phase B candidates to be pursued during the budget year for potential inclusion in the budget. This review will prevent unnecessary resources being expended on projects that have no potential of being approved in the current cycle.

c. Individual PPAR's for consideration of approval to initiate Phase B or C/D of individual programs/projects will be scheduled throughout the year as the programs/projects are ready.

d. An integrated PMC review will be conducted prior to submission of the Agency's budget to OMB. This meeting will focus on final resolution of affordability for all Budget Year Candidates, and programs/projects recommended for approval to initiate Phase B or C/D.

e. PCA validations will be provided by the PAA's for ongoing Phase C, D or E programs/projects with their annual budget submission. The IAR and presentation to the PMC will be conducted after the program/project receives its budget authority for the current fiscal year and has made necessary adjustments.

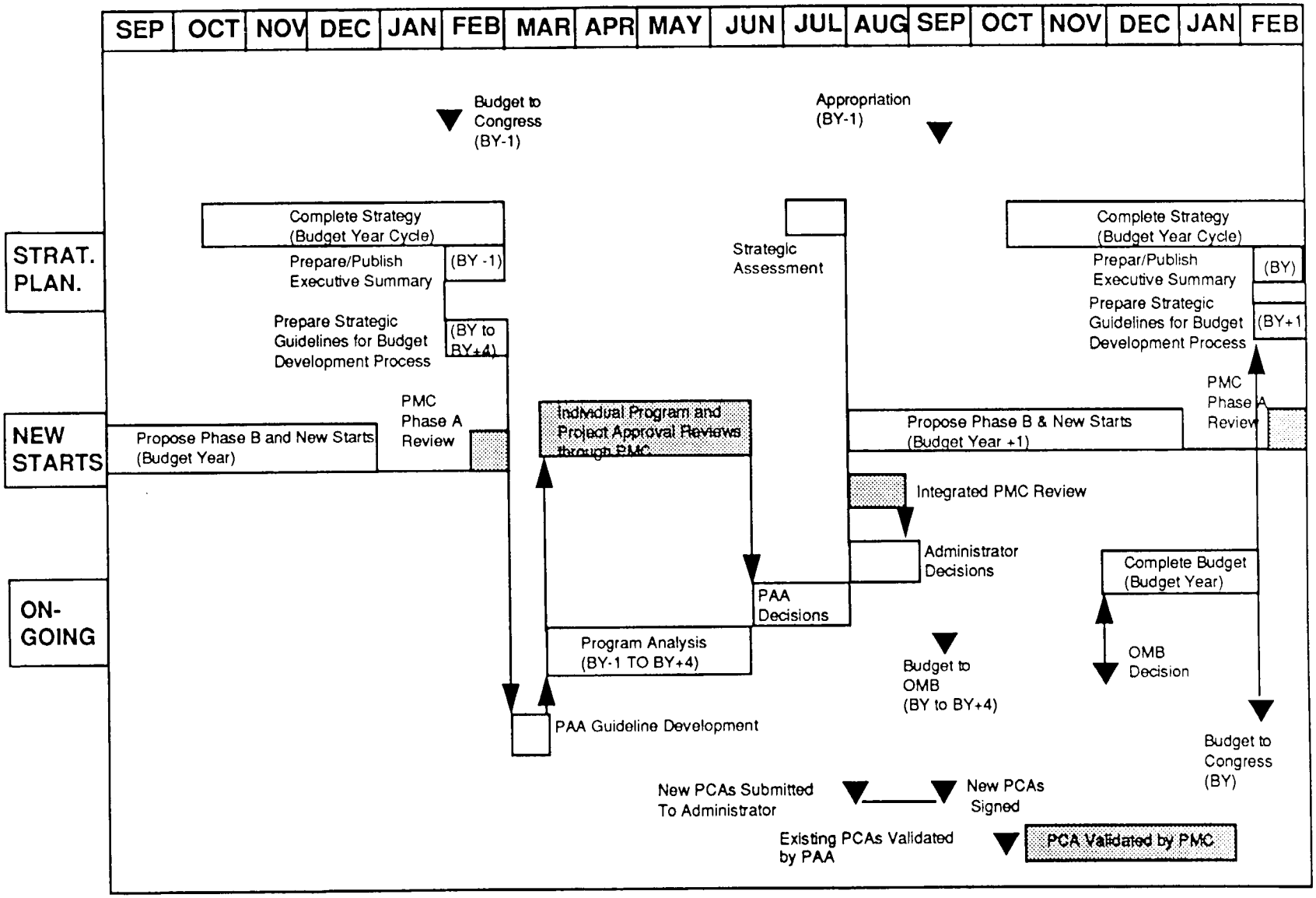

Figure 11-A-1. Agency Strategic Planning and Budget Development Cycle

CHAPTER 11

SECTION B

PROGRAM/PROJECT APPROVAL PROCESS

1. PURPOSE

This section establishes the policies and procedures for the program/project approval process once the PAA has determined that the program/project has achieved all objectives of the current Formulation Phase (A or B) and has recommended that it proceed into the next life cycle phase.

2. POLICIES

a. The PMC shall ensure that all major programs and projects are consistent with Agency strategic planning, affordable, and well-planned up front to reasonably assure that the Agency can deliver its commitments on time and within budget.

b. NARs shall be conducted to provide management with independent assessments and evaluations of major Agency programs/projects to support and verify the readiness decision to proceed into Phase B or C/D.

3. PROCESSES

a. Endorsement Criteria

The PMC reviews will focus on the following four basic questions that must be satisfied in order for the Council to endorse the program/project.

(1) Is the proposed program/project compatible with NASA strategic planning?

(2) Can the projected implementation resource requirements (funding and institutional) be accommodated within expected Agency resources and does the Agency fully intend to support the project through Phase C/D and E?

(3) Have all requirements of the preceding phase been satisfactorily met?

(4) Is the planning for subsequent phases sufficient to ensure a reasonable probability of achieving proposed technical, cost and schedule commitments?

The basis for answering the above four questions will be the MNS, IPS, the proposed Preliminary PCA (if applicable) and the NAR report, including an ICE.

b. Documentation Requirements

(1) Summary. The documentation required for the program/project approval process is identified in Table 11-B-1.

Required Documents	Preliminary PPAR (Prior to Phase B)	PPAR (Prior to Phase C/D/E)
MNS	X	X
IPS	X	X
PCA		X
ICE	X	X
NAR Report	X	X

Table 11-B-1 Program/Project Approval Process Documentation Requirements

(2) Distribution of Copies. Fifteen copies of the documents described in (3) and (4) below are to be provided to the PMC Chairperson in time for distribution to PMC members no later than five working days in advance of the PMC meeting.

(3) Preliminary PPAR. The documentation for this review shall be in accordance with the following:

(a) The cognizant PAA is responsible for the following documents:

- MNS, and

- IPS (Appendix 3).

(b) The NAR Team shall be responsible for preparing a report on the Preliminary NAR regarding validation of data and documentation described in Appendix 4.

(c) The CFO/Comptroller is responsible for documentation of the ICE as part of the Preliminary NAR Report.

(d) The PMC Executive Secretary will be responsible for distributing the upcoming PMC meeting agenda to the PMC members together with the following enclosures: identification of unresolved issues between the NAR Report and the PAA's proposal for the program/ project; the documents described in (a) through (c) above; and the transmittal letter.

(4) PPAR. The documentation for this review shall be in accordance with the following:

(a) The cognizant PAA is responsible for the following documents:

- MNS (validated),
- IPS (updated),
- Preliminary PCA with complete set of supporting commitment agreements.

(b) The NAR Team shall be responsible for preparing a report on the NAR regarding validation of data and documentation described in Appendix 4.

(c) The CFO/Comptroller is responsible for documentation of the ICE as part of the NAR Report.

(d) The PMC Executive Secretary will be responsible for preparing the upcoming PMC meeting agenda to the PMC members with the following enclosures: identification of unresolved issues between the NAR and the PAA's proposed program/project; the documents described in (a) through (c) above, as appropriate; and the transmittal letter.

c. PMC Review Formats

(1) Preliminary PPAR's. These reviews will be conducted in the following format.

(a) The program manager will present program/project data and status in the following order:

- Each topic in sequence from the IPS executive summary. Sections that are not applicable or non-controversial will only

be mentioned.

- Recommendations for program/project scope, requirements, schedule, preliminary cost and corresponding threshold control criteria.

(b) The Preliminary NAR Chairperson will present the results in the Preliminary NAR Report in the following order:

- Program/project validation results in the same order as above;

- ICE;

- Readiness recommendation to proceed to the next phase; and

- Recommendations for program/project scope, requirements, preliminary cost, and schedule.

(c) The program manager and NAR Chairperson will be allocated 30 minutes each for their respective presentations. Following a full discussion of the issues, trade-offs, and proposed scope, requirements, preliminary cost and schedule, the PMC will meet in executive session to determine the Council's recommendations to the Administrator.

(2) PPAR's. These reviews will be conducted in the following format.

(a) A primary presenter will selected by the cognizant PAA to represent the program/ project. In addition, the installation(s) representative(s) to the NASA Engineering Management Council will be included in the presentation. The program/project presentation will include the following topics in the order listed:

- Status of the program/project;

- Update of all elements discussed in the Preliminary PPAR, highlighting deviations from the preliminary baseline and reasons for deviations; and

- Summary of proposed PCA.

(b) The NAR Chairperson will present results of the program/project Phase B readiness assessment in the following order:

- Program/project assessment results in the same order as above;
- ICE;
- Readiness recommendation to proceed to the next phase; and
- Any recommendations for changes to proposed program/project scope and/or performance, schedule, and cost requirements, including corresponding thresholds.

(c) The primary presenter for the program/project and the NAR Chairperson will be provided 45 minutes each for their respective presentations. Following a full discussion of the issues, trade-offs, and proposed threshold control requirements for the PCA, the PMC will meet in executive session to determine the Council's recommendations to the Administrator.

d. PMC Recommendations.

(1) The Deputy Administrator will be responsible for drafting a recommendations memorandum to the Administrator within 24 hours, providing the Council two days to review and comment on this proposed memorandum, and having the final recommendations memorandum to the Administrator within a total of five days of the PMC meeting. The recommendations memorandum will be signed only by the Deputy Administrator.

(2) If the Administrator identifies further issues that must be resolved prior to his approval or authorization to proceed, the cognizant PAA is responsible for resolving the issues in a timely manner and responding back through the PMC Chairperson for potential PMC review and recommendation.

f. Approvals.

(1) The Administrator's approval of the MNS will constitute approval to initiate Phase B. The Deputy Administrator's recommendations memorandum

shall be used as a guideline in the conduct of Phase B unless directed otherwise by the Deputy Administrator or Administrator.

(2) The Administrator's approval of the Preliminary PCA will constitute approval to propose initiation of Phase C to OMB and Congress.

(3) Initiation of Phase C or C/D requires:

(a) Congressional approval; and

(b) Administrator approval of an update to the Preliminary PCA.

Upon receipt of congressional approval of the budget, the PAA will determine the impact on the Preliminary PCA of any change in the budget from that submitted and of any accompanying congressional direction that changes program content or implementation plans. These impacts and corresponding revisions to the Preliminary PCA and other elements of the program will be prepared and presented to the PMC. The Council will then develop a recommendation to the Administrator as to whether to proceed with a revised program/project compatible with the approved budget or to proceed with cancellation. The Preliminary PCA will be updated as necessary to reflect the Administrator's decision. The Administrator's signature on the updated PCA constitutes his approval to initiate Phase C or C/D and establishes this PCA as governing the Phase C/D/E program/project.

CHAPTER 11

SECTION C

PMC REVIEWS OF PROGRAM/PROJECT IMPLEMENTATION

1. PURPOSE

During Phases C, D, and E, the focus of the PMC will shift from ensuring adequate program planning to verifying that commitments are being achieved and that the stated mission needs are being met. This will primarily be accomplished through a series of reviews of program/project implementation.

2. POLICIES

a. The PAA shall establish, maintain, and utilize systems to accurately evaluate program/project status against cost, schedule and technical baselines. Problems or projected violations of thresholds will be identified and reported in a timely manner.

b. The PAA shall validate the PCA annually. The validation will provide the PAA, and subsequently the PMC, with an assessment and evaluation of adherence to technical, schedule and cost commitments and status against corresponding commitment thresholds. The objective will be to assure that technical and programmatic commitments covering the life cycle of a program/project are being fully met and/or to identify potential problems that could threaten the commitments.

c. An IAR to provide an independent objective assessment of the program/project's progress to date, will also be conducted. It will cover the current outlook relative to original plans and expectations and the adequacy of technical and management plans for completing Phases C, D and E. This will include an evaluation of existing or potential technical problems and proposed solutions (including trade-offs) so as to assess whether the PCA thresholds are in jeopardy. This assessment shall be used by the PMC to evaluate the annual PCA validation submitted by the PAA. Conducting a special program/project review may, at the PMC's discretion, negate the need for a separate PCA validation review for that year. However, MR's are not a substitute for the annual PCA validation. Independent reviews will be made available to the PAA so that he/she may reap the benefits from impartial experts with "fresh eyes" taking an objective look at status.

3. IMPLEMENTATION REVIEW REQUIREMENTS

a. Required Reviews

(1) Independent Annual Reviews (IAR's). The IAR will be conducted by a team chartered or "institutionalized" by the CFO/Comptroller. The IAR Team will be copied on all QSR reports. The IAR's focus will be narrower than a NAR and generally require a smaller team to achieve the validation. The IAR team will:

(a) Conduct an independent review, assessment and validation of all PCA elements for the PMC and Administrator as described in Appendix 5.

(b) Provide the Administrator and PMC an annual independent validation of the PCC and DCC covering LCC for the program/project.

(c) Ensure that the program/project thresholds are not violated.

(d) Determine if any program/project deficiencies exist that have not been previously reported and would result in revised program/project projections exceeding thresholds.

(2) Quarterly Status Reviews (QSR's). The PMC will review quarterly status reports. These reports will also be sent directly to the CFO/Comptroller for distribution to the IAR Team.

(3) Special Program/Project Reviews (SPPR's). Special reviews will be conducted as described in Section A, 3.g.(1) and (2) of this chapter. The PMC will charter a team to conduct a special review based on the specific issues to be addressed. These teams can range between a full-up NAR to a small, relatively focused group, depending on the particular issue.

(4) Mission Reviews (MR's). MR reports are reviewed as described in Section A, 4.b.(3) of this chapter and 3.f. of Chapter 10. A decision on exemption from these reviews will be made at the time of program/project approval.

b. Selection of Review Team Chairpersons.

(1) The CFO/Comptroller will select IAR Team chairpersons.

(2) The Deputy Administrator shall select SPPR team chairpersons.

(3) The PAA's shall select MR team chairpersons.

(4) Chairpersons shall not be selected from among the sponsoring PAA's office personnel.

(5) Chairpersons shall not be selected from among the host field installation personnel.

c. Selection of Review Team Members.

(1) Chairpersons shall select the review team members.

(2) The IAR Team will include necessary technical and support personnel to adequately verify that program commitments in the PCA are being met. If particular problems or trouble areas are known, experts or specialists for those disciplines must be placed on the team. In order to eliminate coming up "on the learning curve," the IAR Team should include members from the previous cognizant NAR Team. To the extent possible, continuity of the IAR Team should be maintained.

(3) For a MR team, the emphasis should be on selecting personnel with skill in integration and test, launch vehicle and vehicle operations, mission operations and data analysis.

(4) Team members should not be selected from personnel within the advocacy chain for a program/project. If possible, team members should be selected from other than the sponsoring PAA's office or HFI.

(5) All independent review team chairpersons must exercise care during the creation of the review team to assure compliance with the applicable provisions of the Federal Advisory Committee Act and the Federal Property Management Regulations Rule on Federal Advisory Committee Management.

d. Review Timing.

(1) Independent Annual Reviews (IAR's). This review is timed to the budget process; however, if the review is conducted near the time of a major project/program milestone, the process must allow time for the results to be incorporated into PCA validation. The PAA's PCA validation will be submitted to the PMC at the same time as his overall budget recommendation to the Agency. The

independent review will be conducted as soon as practical after the PAA's PCA submission. If a program/project continues in Phase B for more than one year past execution of a PCA, the PMC will determine the necessity of IARs prior to budget authority to initiate Phase C.

(2) Mission Reviews (MR's). The timing of these reviews is generally independent of the NASA budget cycle. The timing will be proposed by the PAA to coincide with key operational milestones.

e. IAR Reporting Requirements.

(1) The IAR Team shall prepare a report which addresses the current technical, cost and schedule commitments, presents the team's assessment of their validity, and provides corresponding recommendations. The latter shall include any proposed changes to the PCA and the rationale for these changes. The report shall also include minority positions in the event team consensus is not obtained.

(2) The CFO/Comptroller will review the results of all IAR's and provide for their subsequent oral presentation to the PMC.

CHAPTER 11

APPENDIX 1

PROGRAM MANAGEMENT COUNCIL CHARTER

1. BACKGROUND

NASA requires a well-defined system of integrated planning, approval and implementation for Agency programs to assure that the Agency initiates programs consistent with its strategic planning and available resources and conducts them in accordance with the commitments made for each program it initiates. The Agency also requires a forum to involve the highest level of program officials in efforts to address issues pertaining to PPM policy and implementation.

2. OBJECTIVE

The objective of the PMC is to provide an Agency-level forum for addressing planning, implementation and management of all major Agency programs. It shall support the Deputy Administrator in:

a. Assuring that the Agency functions as an integrated system in planning, approving and implementing its mission to meet its commitments within available resources;

b. Meeting his/her functional management responsibilities including PPM policy and process development, maintenance and oversight.

3. FUNCTIONS

a. Major System Program/Project Formulation and Implementation. The PMC will accomplish integrated:

(1) Planning, approval and status readiness evaluations to the Administrator for all candidate major system programs and projects;

(2) Review and assessment of those subsequently approved programs and projects from their initiation through completion of mission operations; and

(3) Review of affordability and recommendation to the Administrator of new program/project initiation and changes to approved programs/projects in support of the annual budget process.

In accomplishing these functions, the Council will address the following program/project formulation and implementation related matters:

(1) Compatibility of Phase B candidates with NASA strategic planning and with projected resources availability (funding and institutional);

(2) Adequacy of proposed program/project planning and management;

(3) Readiness for initiation of Phase B;

(4) Readiness to submit new start requests for Phases C or C/D;

(5) Conformance of programs/projects to their PCA's through review of program/project status reports and independent validations;

(6) Performance on major contracts;

(7) Recommended cancellation or continuation of programs and projects, as required; and

(8) Special issues arising in the planning and execution of Agency major system programs.

b. Technology and Advanced Development Program Review and Assessment. The Council will review, assess and make recommendations regarding major technology and advanced development programs with emphasis on commercial benefits after considering future mission need, potential for multi-mission or multi-program use, potential return on investment (in terms of both cost and performance) for both Agency and commercial use, readiness to begin the proposed phase of R&T development, and the realism of the funding profile and identified Agency and commercial benefits.

c. Program/Project Functional Management Support. The Council will serve as the Agency's highest level forum for addressing issues related to PPM (including acquisition) policies, systems and processes. For this purpose, the Council's programmatic functions will include providing oversight to ensure conformance with these Agency policies, systems and procedures. The Council will identify needed revisions resulting from this oversight and review and assess proposed revisions from all sources.

4. MEMBERSHIP

The PMC will consist of the following:

- Deputy Administrator, Chairperson
- Associate Administrator for Advanced Concepts and Technology
- Associate Administrator for Space Systems Development
- Associate Administrator for Space Flight
- Associate Administrator for Space Communications
- Associate Administrator for Aeronautics
- Associate Administrator for Space Science
- Associate Administrator for Life and Microgravity Sciences and Applications
- Associate Administrator for Mission to Planet Earth
- Associate Administrator for Safety and Mission Quality
- Comptroller
- Associate Administrator for Procurement
- General Counsel

5. OPERATION

A PMC Executive Secretary will be appointed by the Deputy Administrator to support the PMC activities. The PMC Executive Secretary will be responsible for preparing the PMC's schedules and meeting agendas for approval by the Deputy Administrator. All documentation to be distributed to the PMC in advance of meetings will be submitted to the Executive Secretary.

As Chairperson of the Council, the Deputy Administrator is authorized to convene the Council, as necessary, to discharge the responsibilities and perform the functions of the Council. Attendance and participation by others will be as determined by the Chairperson. The results of the Deputy Administrator's assessments will be presented to the Administrator in the form of findings and recommendations.

CHAPTER 11

APPENDIX 2

PROGRAM/PROJECT MANAGEMENT STEERING GROUP CHARTER

1. BACKGROUND

The Deputy Administrator serves as the Agency functional manager for PPM. In order to meet this and other PPM related responsibilities, the Deputy Administrator has established and chairs the PMC comprised of the program and other selected AA's. However, the functional management responsibilities of the Deputy Administrator also require a support mechanism for addressing PPM policy, process and related issues.

2. OBJECTIVE AND FUNCTIONS

The objective of the PPMSG is to support the Deputy Administrator in meeting his PPM functional management responsibilities through performance of the following:

a. Development of proposed Agency-level PPM policy additions, deletions and revisions for review by the PMC;
b. Assuring development of proposed detailed policies and procedures required to implement Agency-level PPM policy and their subsequent review and endorsement to the PMC;
c. Provision of oversight of the PPM Training and Development Program and presentation of corresponding findings and recommendations to the PMC;
d. Provision of direction and oversight of all PPM working groups; and
e. Provision of other PPM functional management related support as requested by the Deputy Administrator/PMC.

3. MEMBERSHIP

The PPMSG shall be comprised of senior Headquarters and field installation personnel from the Agency PPM community. The PPMSG Chairperson shall be a Deputy AA of a program office with major system development responsibilities and shall be appointed by the Deputy Administrator. The other members of the PPMSG (including alternates) and an Executive Secretary will be selected by the PPMSG Chairperson in consultation with the cognizant AA or FID. The Headquarters members will be selected from among the offices having major responsibilities for system development program management and the Offices of the Comptroller, Procurement, and Safety and Mission Assurance. These Headquarters members (including alternates) shall be at the Deputy AA/Division Director

level. Field Installation members (including alternates) shall be at the Director For/Deputy Director For level.

4. OPERATION

The PPMSG will report to the Deputy Administrator. The PPMSG Chairperson is authorized to convene the Steering Group as necessary to perform the PPMSG functions. Attendance and participation by others will be as determined by the PPMSG members except for any executive sessions where attendance will be as determined by the Chairperson. Meeting minutes will be prepared by the PPMSG Executive Secretary.

CHAPTER 11

APPENDIX 3

INTEGRATED PROGRAM/PROJECT SUMMARY (IPS)

This Appendix provides instructions for preparing the IPS in support of a PPAR. The IPS is the primary document used to facilitate top-level decision making on the readiness of programs/projects to proceed into Phase B or Phase C/D. It provides a comprehensive summary of program structure, plans, status, assessment, and recommendations by the Program Manager and PAA. Primary functions of the IPS include:

a. Summarizing where the program is versus where it should be;

b. Describing where the program is going and how it will get there;

c. Identifying program risk areas and plans for closing risks; and

d. Providing the basis for establishing explicit program/project cost, objectives, schedule, and performance (operational effectiveness and suitability). For the Phase C/D review, proposed thresholds will be included. Specific exit criteria for the next program/project phase will be recommended.

The format and content of the IPS are attached. The document should not exceed 20 pages in length.

INTEGRATED PROGRAM/PROJECT SUMMARY

(PROGRAM/PROJECT TITLE)

Provided For:

_____ Preliminary Program/Project Approval Review

_____ Program/Project Approval Review

Recommended By:

Field Installation Director or HFI Program Manager	Date	Organization
Program Associate Administrator	Date	Organization

IPS Cover Sheet Format/Content

INTEGRATED PROGRAM/PROJECT SUMMARY
(PROGRAM/PROJECT TITLE)

1. PROGRAM/PROJECT DESCRIPTION

A summary level description of the program/project and the mission needs to be met.

2. BACKGROUND

a. Describe how the exit criteria in the prior recommendations memorandum from the Deputy Administrator or as amended by the Administrator were satisfied.

b. Summarize any subsequent guidance, decisions and Congressional actions.

c. Provide the current program/project and contract(s) status of:

(1) Cost estimate-at-completion,
(2) Schedule, and
(3) Achieved performance.

d. Summarize major cost, schedule and performance trade-offs made during the previous phase and to be made during the next phase.

e. Program funding status relative to:

(1) Prior years,
(2) Current budget, and
(3) Outyear extended plan for funding program completion.

Include and discuss obligation status for prior and current year funding.

3. SYSTEM CONCEPT(S)

a. At the Preliminary PPAR:

(1) If a new system is proposed, discuss why use of an existing system (government or commercial), or product improvement of an existing system was not selected.

(2) For the most promising concept, identify existing government or commercial non-development items (subsystems), which will be evaluated for use or

possible modification during the next phase.

b. At the PPAR:

(1) Describe program/project progress since the Preliminary PPAR, including contract performance and the results of test and evaluation.

(2) For the most promising design, identify which subsystems, components or materials require new or additional development. Discuss why an existing government or commercial non-development item subsystem, component or material cannot be used. Identify supporting analyses.

4. RESULTS OF ASSESSMENTS OF ALTERNATIVES

a. Identify all alternatives considered.

b. Discuss selection criteria and how they relate in priority order to the mission need.

c. Discuss rejected alternatives and reasons for their non-selection.

d. Summarize the cost, relative cost effectiveness, schedule, and performance assessment of the most promising alternative and the supporting rationale relative to the MNS.

5. ENVIRONMENTAL ANALYSIS

Summarize any potential impacts to the environment or public health and safety. Identify the type of environmental analysis conducted. Summarize whether the concept/system alternative chosen is environmentally preferable to other alternatives. If an environmental impact statement is conducted, summarize public response.

6. PROGRAM STRUCTURE

Summarize the organizational structure from the cognizant PAA through project manager, highlighting the PCA and supporting agreement officials. The initial structure and any planned evolution should be provided for the life of the project. Key approval and authority levels should be highlighted. Top level relationships to other organizations must be summarized. Key personnel(positions and qualifications) should be provided.

7. ACQUISITION STRATEGY

Summarize the acquisition strategy, highlighting the business

and contractual management approach designed to achieve program objectives within the resource constraints imposed.

8. CONTROL SYSTEMS AND PROCESSES

   a. Summarize the key program/project control systems and processes, including specific metrics to be tracked during execution of the phase.

   b. Summarize the key elements of contractor management and cost control.

9. INSTITUTIONAL REQUIREMENTS

   a. Summarize the program/project's technical, management, budget and institutional support needed to accomplish the program/project on schedule and within budget.

   b. Highlight where Agency augmentation of resources, civil service workforce, or existing infrastructure is required.

   c. Discuss potential for reducing Agency augmentation needs through use of existing outside government and commercial resources.

10. LIFE CYCLE COST ESTIMATE

    Summarize the PCC and the cost estimates for workforce (civil service and contractor) and other institutional support requirements. Groundrules and assumptions should be stated. Include identification of the components of the PCC.

11. RISK ASSESSMENT

    a. Provide a succinct summary of the five facets of risk: technical (performance, safety, and reliability), supportability (operability and maintainability), programmatic (environment related), cost, and schedule. Identify the system component(s) or subsystem(s) most directly affected, and the actual or planned specific risk reduction efforts or risk management planning being undertaken by the program/project manager.

    b. Summarize any additional potential mitigating measures.

    c. Summarize order of descope options if funding authorization is reduced from targeted budget authority and alternatives that could be exercised in the event descoping becomes necessary. Summarize impacts to LCC and schedule, as well as performance.

12. AFFORDABILITY ASSESSMENT

Discuss whether or not the proposed program/project can fit within the existing funding availability and institutional capability in the near-term through the budget horizon (approximately five years) and for the entire program life cycle. If not, describe what adjustments would have to be made to the program to fit within projected resource availability, particularly for the upcoming budget year. Provide what alternative strategies including offsets, tradeoffs, and/or other adjustments, could be employed.

13. COMMERCIAL TECHNOLOGY DEVELOPMENT

Summarize the commercial technology aspects and benefits.

14. EXTERNAL PARTICIPATION

Summarize the involvement by other government agencies, the commercial sector, or foreign governments in the development of the program/project being considered. Briefly discuss advantages and disadvantages of this participation. Discuss the potential use by the commercial sector, other government agencies, or foreign governments and potential spin-off technology opportunities.

15. RECOMMENDATION

Recommend the proposed acquisition strategy, major trade-offs to be made by the milestone decision authroity, proposed exit criteria, commitments and threshold values, and whether or not to proceed into the next phase. Identify any issues that require resolution by the PMC or Administrator.

CHAPTER 11

APPENDIX 4

NON-ADVOCATE REVIEWS (NAR)

1. PURPOSE

A NAR provides an independent assessment of a candidate program/project's plans, LCC status and readiness to proceed to the next phase of the project life cycle. The NAR is conducted by a team comprised of highly knowledgeable specialists from organizations outside of the advocacy chain of the program/project. The findings, issues, concerns and recommendations of the NAR Team are used to:

a. Support the PMC in its deliberative process for developing recommendations to the Administrator regarding approval or disapproval to initiate Phase B or Phase C/D.

b. Support PAA decision making regarding readiness to request that the PMC meet to recommend program/project approval or disapproval for entry into the next phase.

c. Reinforce Agency ability to "deliver on commitments."

2. POLICIES

a. Each project requiring PMC endorsement for proceeding to Phase B or Phase C/D shall undergo a NAR to provide the PMC an independent assessment and evaluation of the readiness to proceed.

b. Each NAR shall provide an independent evaluation of the program's/project's: clarity of objectives; thoroughness/realism of technical plans and schedules and of costs; adequacy of management plans, including organizational structure and key personnel credentials; and technical complexity. The NAR evaluation of technical, cost and schedule risks, and reserve allowances in schedule and cost for all life cycle program elements, will enable the PMC to answer the four basic questions cited in Section B, paragraph 3, of this Chapter.

c. If the program is changed substantially after the NAR, then the program must reenter the NAR process.

3. NAR TEAM SELECTION

a. The Deputy Administrator shall select the chairperson of

the NAR Team.

(1) The Chairperson shall not be selected from among the sponsoring PAA's office personnel.

(2) The Chairperson shall not be selected from among the host project field installation's personnel.

b. The Chairperson shall select the remainder of NAR Team, which shall, at a minimum, consist of experts/specialists knowledgeable in the following areas:

(1) Project Management;

(2) Science and Technical Disciplines;

(3) Ground Systems Implementation/Mission Operations;

(4) Program Control;

(5) Procurement; and

(6) Resources (from the HQ Office of the Comptroller).

c. Team members should not be selected from personnel within the advocacy chain for a program/project. If possible, team members should be selected from other than the sponsoring PAA's office or responsible field installation.

d. To the extent possible, continuity of the NAR Team membership should be maintained from review to review.

e. The Chairperson of the NAR Team must exercise care during the creation of the NAR Team to assure compliance with the applicable provisions of the Federal Advisory Committee Act and the Federal Property Management Regulations Rule on Federal Advisory Committee Management.

4. SCHEDULE

a. The NAR process must allow time for the results to be incorporated into the NASA budget process.

b. To ensure that there is adequate time to conduct the NAR and prepare and present results, the following time requirements should be accommodated:

(1) Approximately four weeks are required for:
- Deputy Administrator to select the NAR Chairperson,

- NAR Chairperson to select the NAR Team,
- Program/project staffs to prepare presentations,
- NAR Team to review advanced information packages;

(2) Approximately three weeks are required for:
- NAR Team to conduct the full scale review,
- Program/project staffs to prepare responses to NAR open items and requests for additional information,
- NAR Team to research special issues/obtain additional expert opinions;

(3) Approximately three weeks are required for:
- NAR Team to prepare report,
- NAR Team to present findings to the cognizant PAA; and

(4) Approximately one week is required to prepare program/project responses to NAR findings and recommendations.

c. Presentations to the PMC for a program/project's approval to enter into the next phase must be completed to allow sufficient time for the recommendation to be incorporated into the PAA's budget submission.

5. PROCEDURES

To effectively support the PMC in its recommendation for progressing into either Phase B or Phase C/D, the NAR Team must gain a thorough understanding of the present position of the program/project, as well as an understanding of the major trade-offs and alternatives explored by the design team.

a. Advanced Information. The cognizant program/project office will compile a representative set of existing briefing packages and descriptive reports of the program/project. The compilation will be sent to the NAR Chairperson for distribution to the team in advance of an on-site visit.

b. Program/Project Manager's Presentation to NAR Team (Minimum Content). The cognizant program/project management will brief the following information to the NAR Team:

(1) Program Background

(a) Programmatic background - Where the program/project fits in NASA strategic planning,

(b) Historical background - Mission need, including identification of stakeholders,

(c) Scientific background, and

(d) Technological background.

(2) Scientific and Technological Objectives

(a) Primary goals and objectives and their rationale (including relation to strategic planning),

(b) List of key objectives/questions (with priorities) that drive mission requirements and implementation plans,

(c) Schedule sensitivities of objectives.

(3) Program/project documentation status

(a) Fill out appropriate checklist from Table 11-4-1 or 11-4-2 (preliminary NAR and NAR respectively).

(b) Provide similar status of other documents as requested or as deemed necessary.

(4) Implementation Plan

(a) General.

(i) Is this program's success dependent on other NASA programs?

(ii) Are there any external dependencies (DoD, NOAA, International partners, etc.)?

(iii) Is there a research/technology transfer plan?

(iv) Will any required funding come from outside of NASA?

(b) Design Requirements

(i) Summary

(ii) Feasibility - Phase A or Phase B study results

(iii) Complexity assessment

(iv) Trade-off studies/decisions

Document	Available	Schedule Date	Not Applicable	Point of Contact
MNS				
Acquisition Strategy				
AO				
NASA Research Announcement				
Phases B/C/D RFP				
Project Plan				
System Performance Requirements				
Environmental Analysis				
Preliminary Systems Specification				
Phase A Study Report				
LCC Estimate				

Table 11-4-1. Preliminary NAR Document Checklist

(c) Design

(i) Technology development and/or demonstration requirements, current status, and advanced technical development plans.

(ii) Conceptual diagram of flight article.

(iii) Subsystem and instrument descriptions including as necessary:
- Requirements
- Configuration/hardware elements
- Heritage/off-the-shelf hardware assumptions
- Complexity assessments

(iv) Resources allocations - summaries by subsystem, including margins for:
- Weight
- Power
- Data Rate
- Computer Memory

Document	Available	Schedule Date	Not Applicable	Point of Contact
System & Subsystem Specifications				
Program and Project Plans				
PCA				
Descope Plan				
Mission Success Criteria				
Preliminary SRR Results				
WBS and WBS Dictionary				
Schedules				
Environmental Analysis Update				
Interface Control Documents				
MOUs, MOAs or Other Program/Project Agreements				
Technology Transfer Plan				

Table 11-4-2. NAR Document Checklist

(v) System integration and test process - assumptions and flows

(vi) Software requirements, sizing, margins, heritage, production methods

(vii) Safety, reliability and quality assurance

(viii) Supporting systems (launch vehicle, non-NASA elements, tracking, etc.)

(ix) Mission operations and data processing

(x) Facilities including outfitting

(d) Management

(i) Roles and mission assignments

(ii) Management organization and key personnel

(iii) Acquisition strategy

(e) Funding Resources

(i) Resources already brought to bear on the program.

(ii) Ground rules and assumptions used as basis for LCC estimate.

(iii) The LCC estimate including all program/project unique identifiable costs from Phase B through Phase E for:

a) Development (all program/project elements to the subsystem level)

b) Operations

1) Operations capability development

2) Mission operations - through end of mission (by function)

3) Data analysis during the approved operational lifetime (excludes post-mission analysis)

c) Cost of facilities, including outfitting

d) Launch vehicle(s)

e) Tracking and data acquisition

f) Institutional support - excluding Civil Service workforce

g) Other program/project unique costs

(iv) Type of cost estimate (grassroots, analog, parametric, expert advice)

a) If analog is used, demonstrate relevance in measurable manner

b) Support all estimates with details

(v) Identify phased funding levels to meet objectives

(f) Human Resources - Phased workforce to meet objectives (contractor and civil service, by field installation, by year)

(g) Implementation Schedule

(i) Basis for schedule, how time estimates were developed

(ii) How schedule is supported by phased resource requirements

(iii) Schedule sensitivities

(iv) "Best possible" and "minimum risk" schedules

(h) Program Risk

(i) Risk assessment

(ii) Plans for mitigating risk (schedule, resources, etc.)

(iii) Contingency and APA recommendations including supporting rationale

c. NAR Report.

(1) Format - The format of a brief narrative providing an overview/evaluation of each major evaluation area followed by specific Findings, Concerns/Issues and Conclusions/Recommendations, should be observed unless found to be unusable for a particular program/project.

(2) Organization - The report should be organized similarly to the IPS (Appendix 3). Each evaluation area should consist of these basic sections:
- Cover Sheet,
- NAR evaluation (brief narrative)
- Specific Findings, Concerns/Issues, and
- Conclusion/Recommendation.

(3) Evaluation Areas - The major evaluation areas to be reported are:

(a) Program/Project Description

(i) Very general description of program
- Goals and objectives
- Hardware proposed to achieve objectives

(ii) Mission need and relationship to Agency strategic planning

a) Role of program vis-a-vis strategic planning

b) Program/project objectives

c) MNS

(b) Background

(i) Satisfaction of previous exit criteria (if applicable)

(ii) Maturity and complexity of technologies
- Technical difficulty/tall poles
- Heritage of subsystems and age of claimed heritage
- Amount of new design
- Off-the-shelf elements
- New technologies required
- State-of-art breakthroughs required

(iii) Overall status of the program/project

a) Funding situation

b) Schedule performance
- Schedule adequacy
- Critical path analysis - slack available
- Associated cost risk

c) Performance

d) Problems/issues

(c) Systems Concepts

Alternatives with rationale for the selection of the most promising alternative

(i) Alternative approaches studied

(ii) Trade analyses completed

(d) Results of assessments of alternatives

(e) Environmental analysis

(f) Program Structure

(g) Acquisition Strategy

(h) Control Systems and Processes

(i) Management

a) Management approach

b) Management and organizational structure

c) Center commitments - workforce, facilities, resources

d) Contractors reports/reviews, WBS, PMS, etc.

(ii) Technical

a) Status of Phase A and B reviews

b) Program/project oversight and review plan

c) Descope/cost containment plans

d) Documentation in-place or scheduled - see Tables 11-4-1 and 11-4-2

(iii) Contractor Management and Cost Control

(i) Institutional Requirements

(j) Life-Cycle Cost

(i) Value of definition investment to date

(ii) Groundrules and assumptions supporting Phase B or Phase C/D entry decision estimates for:
- Design/development
- Operations
- Other life cycle program elements

(iii) Program/project cost and schedule comparisons phased by Fiscal Year (in both constant and real-year dollars.)

(k) Risk Assessment and Risk Reduction/Descope Options

(i) Technical - Assessment of relative risk

levels for entire program/project
- State-of-the-art challenges
- Risk assessment by program/project elements

(ii) Cost - Reserve requirements/ allocation/spread analysis

(l) Affordability Assessment (provided upon specific direction of the PMC)

(m) Commercial Technology Development (Technology Transfer)

(n) External Participation

(4) Recommendations - Major recommendations regarding the planned program/project scope, requirements, cost, schedule and threshold control criteria are to be summarized in the final section of the NAR Report.

CHAPTER 11

APPENDIX 5

INDEPENDENT ANNUAL REVIEWS (IAR's)

1. PURPOSE

An IAR provides an independent examination of a major system program after it has been approved and a baseline established. The purpose of the review is to:

a. Advise the PMC as to progress and current status of the program regarding meeting its cost, schedule, and technical commitments.

b. Alert the PMC if a program/project threshold is projected to be breached.

c. Assess the adequacy of the annual funding amounts included in the Agency budget submission.

2. POLICIES

a. It is NASA's policy that an IAR shall be conducted on all programs for which a PCA is in effect. The IAR will review and evaluate the cost, schedule and technical content of the program over its entire life cycle. The IAR shall determine if any program deficiencies exist that would result in revised program/project projections exceeding thresholds. To accomplish this, sufficient information must be provided by all the necessary levels of management responsible for execution of the program.

b. The IAR shall support the deliberative process through the PMC by helping it provide realistic status on Agency commitments.

c. The CFO/Comptroller shall ensure continuity of reviews and establish standards for their conduct.

3. PROCEDURES

a. Selection of the IAR Team.

(1) The CFO/Comptroller shall select the IAR Chairperson.

(2) The Chairperson shall select the remainder of the IAR team. At a minimum the team will consist of members of the Comptroller's staff who have experience in cost estimating and program analysis.

Additional personnel from engineering and science disciplines may be included as well. Membership from the original NAR Team should be obtained to as great an extent as practical.

(3) The CFO/Comptroller will ensure that there is a continuity of the IAR membership from one year to the next for a specific program.

b. Process

(1) The IAR Team shall familiarize themselves with the program/project prior to initiating the IAR by reviewing reports from past NAR's, and IAR's, as well as other pertinent documents and reports on file in the CFO/Comptroller's office.

(2) The IAR Team will review the program baseline for cost, performance, and schedule at a level of detail sufficient to verify conformance to commitments and thresholds. It will also review the PAA's control processes and procedures. The review will assess progress to date against the plan to date and assess risk for completing future efforts as planned. The program/project presentation to the IAR Team should include at minimum:

(a) Quick overview of program/project background for new IAR team members;

(b) Status and changes since the last NAR or IAR regarding the following:

- Primary goals and objectives
- Scientific and technical objectives that drive mission requirements and implementation plans.
- Implementation Plan described in Appendix 4, Section 5b(4). (A complete rebriefing as required in a NAR is not necessary.)

(3) A cost assessment will be performed which will examine contractor data such as provided by NASA 533Qs and performance measurement systems. Authorized but undefinitized changes, planned changes not yet authorized, and any other modifications or future requirements will be considered. The adequacy of reserve levels should be part of the cost assessment.

(4) A schedule assessment shall be conducted which examines milestone achievement against the original

baseline, critical path analysis and schedule margin adequacy.

4. IAR REPORT

The format/content of the IAR Report to the PMC should be as follows:

a. Current Program Status

(1) Technical progress made to date against the baseline.

(2) Costs incurred against the baseline.

(3) Schedule performance against the baseline.

(4) Funding situation.

(5) Assessment of PAA proposed changes to the PCA.

b. Program Evaluation

(1) An assessment of any changes to the relative risk of the program achieving its fundamental mission objectives, while adhering to commitments and thresholds.

(2) A comparison of assessed cost, schedule, and technical with the corresponding thresholds established in the PCA along with a comparison against the PAA's current position.

(3) A comparison of funding requirements by year proposed by the PAA with those included in the assessment.

(4) An explanation of key issues identified by the IAR Team.

c. Recommendations

The report should contain any recommendations to the PMC relative to conformance with and required changes to the PCA, including any issues that raise concerns on the program achieving its fundamental mission objectives that may not be reflected in a specific threshold. The report should also include any recommendations for any additional reviews or individual program briefings that the IAR Team deems necessary. This shall specifically include a recommendation as to whether or not a CR is required.

The IAR Report will include minority reports in the event team concensus is not attainable.

5. SCHEDULE AND REPORTING REQUIREMENTS

a. The IAR shall be conducted once each FY after the program/project receives its NOA for the current FY and has made necessary adjustments.

b. The IAR Team will present the results of the review to the PAA at least three weeks in advance of submission of the report to the PMC to allow adequate time for the PAA to prepare responses to IAR Team recommendations and issues.

c. Fifteen copies of the IAR Report will be forwarded from the CFO/Comptroller's Office to the PMC Executive Secretary for distribution to the PMC.

d. The CFO/Comptroller is responsible for presentation of the IAR results to the PMC.

e. The Deputy Administrator will prepare a report for the Administrator delineating his/her view of the program/project progress and status within five working days of presentation of the IAR's results to the PMC.

APPENDIX A

DEFINITIONS

Acceptance Test. A formal test conducted to demonstrate acceptability of an item for delivery and flight. It is intended to demonstrate conformance to specification requirements and to act as a quality control screen to detect deficiencies in workmanship, material, processes and quality.

Acquisition Executive. The senior official in Headquarters responsible for integrating and unifying the management process for the agency's major system acquisitions and for monitoring policy implementation.

Affordability. The ability of NASA to provide funding and other resources to acquire and operate the system as determined by the cognizant program office and CFO/Comptroller and confirmed by the Deputy Administrator/PMC.

Allowance for Program Adjustment (APA). Resources allocated for: expansions in project requirements resulting from Headquarters approved changes in project objectives or scope; the resolution of unforeseen major problems; project stretch outs from agency funding shortfalls, etc. These resources are managed by the Headquarters program office.

Cancellation Review (CR). A review by the Deputy Administrator/PMC for the purpose of securing their recommendation as to whether to cancel or continue a major system program or project which is in Phase C or D and for which the EAC is projected by the PAA or the CFO/Comptroller to exceed its PCC or the DCC component of the PCC by more than 15 percent.

Class 1 Competition. A Phase B competition designed to solicit proposals for alternative system design concepts to accomplish a mission need.

Class 2 Competition. A Phase B competition designed to solicit proposals for a pre-determined single system design concept to accomplish a mission need.

Contingency Resources. Resources allocated to and managed by the Project Manager for the resolution of problems normally encountered while assuring compliance to the specified project scope.

Development Cost Commitment (DCC). The cost ceiling established by the Administrator for the total costs to be incurred in Phases B through D of the project life cycle.

End-to-End Test. A test performed on the integrated ground and

flight system, including its control, stimulation, communications, and data processing to demonstrate that the entire system is operating in a manner that can fulfill all mission requirements.

Host Field Installation (HFI). That field installation which is responsible for providing the institutional support for the program manager function in addition to its responsibilities for assigned projects and/or assigned program/project implementation support tasks.

Independent Annual Review (IAR). An annual review of the status of the commitments, performance, cost and schedule commitment in a PCA as compared to the program/project baseline and established thresholds. IARs are a responsibility of the CFO/Comptroller. The results are provided to the PMC.

In-house Project. A project conducted on-site or in the immediate vicinity of a field installation in which essentially most major technical, business and management tasks normally performed by a prime contractor are performed by the installation's civil service staff.

Institutional Resources. The human resources, facilities, equipment, information resources, and administrative and program support services comprising the NASA institutional infrastructure.

Integrated Program/Project Summary (IPS). An IPS is the primary decision document furnished by the PAA to the PMC providing a comprehensive summary of program/project structure, status, assessment, plans, and recommendations by the Program/Project Manager and the PAA.

Level Funded Program. A Congressional approved program fund which allows the peer review process to select and initiate discrete projects as accommodated within the overall program funding level.

Life Test. A test conducted to verify that a system or system element can meet performance requirements at required stress levels over a specified number of cycles and/or time, including storage.

Life Cycle Costs (LCC). The total of the direct, indirect, recurring, non-recurring, and other related costs incurred, or estimated to be incurred, in the design, development, production, operation, maintenance, support, and retirement of a system over its planned life span. Life-cycle costs are the costs incurred in Phases B through E, including development and facility construction costs and the project unique costs, such as launch vehicles, tracking and data acquisition, and institutional support exclusive of civil service workforce costs. Also excluded are the undistributed costs of launch vehicles, tracking and data acquisition, science, post-Phase E (Operations) data analysis, base research and technology (R&T), focused technology, and the non-reimbursable costs of other agencies and governments.

Major Program/Project. A program/project for system(s) development and operation that:

(1) Is directed at and critical to fulfilling an agency mission;

(2) Entails the allocation of relatively large resources; or

(3) Warrants special management attention.

The above include but are not limited to:

(4) All programs/projects for which external agency reporting on a regular basis is required;

(5) All multiple field installation programs; and

(6) All projects whose DCC's exceed $200 million.

Margin. The difference between a cost, schedule or technical threshold and the current expected value of the parameter

Mission. A system capability required to accomplish an Agency mission or to effectively pursue a scientific, technological, or engineering opportunity directly related to an Agency mission. These needs are independent of any particular system or technological solution.

Mission Need Statement (MNS). The document that establishes the justification for undertaking an Agency objective or effectively pursuing an opportunity pertaining to an Agency objective. It is the document that grants authority to initiate a Phase B effort for a candidate project.

Mission Review (MR). A review of a flight project conducted for the Deputy Administrator/PMC by a group of independent experts to provide an independent assessment of progress toward or readiness for mission operations.

Non-Advocate Review (NAR). A review of a proposed major system project by a non-advocate team appointed by and reporting to the Deputy Administrator. The NAR Team is comprised of experienced project management, technical, and budget personnel drawn on an ad hoc basis from organizations that will not participate in the implementation of the proposed project. These reviews provide Agency management with independent assessments of the adequacy of the project formulation effort.

Non-Reimbursable Costs. Costs incurred by NASA in program/project formulation and implementation efforts performed on the behalf of another United States government agency or a foreign government and for which NASA is not reimbursed.

Phase A - Preliminary Analysis. The analysis of a proposed agency technical objective or mission and alternative approaches and concepts for its accomplishment sufficient to establish need, validate feasibility, and prepare an RFP to initiate the acquisition process. Phase A begins with PAA approval of a request to initiate a Phase A effort (or direction by the PAA to do so) and is complete with submission of a proposed MNS to the Administrator for approval.

Phase B - Definition. The effort necessary to understand the full range and implications of implementing a proposed project and defining the technical and management implementation approaches sufficient to make an agency commitment to fully accomplish the project technical objective or mission on schedule and within budget. Phase B begins with approval of the MNS and ends with revalidation of the PCA or Administrator approval of an updated PCA necessary to accommodate specific provisions of the full ATP from Congress.

Phase C - Design. The effort required to generate the system(s) critical design and test and verification plans. Phase C begins with approval of the revalidated or updated PCA and concludes with satisfactory completion of the CDR.

Phase D - Development. The effort required to produce system(s) operational readiness. Phase D begins with the satisfactory completion of CDR, and for programs where full scale production of multiple units is required, with the Administrator's written approval. Phase D is complete with acceptance of the system(s) by the ultimate user.

Phase E - Operations. All activities commencing with acceptance by the ultimate operator of the system(s) that are necessary to accomplish the technical and scientific objectives of the project. These include post-launch development, maintenance, planned upgrades and selected data analyses. Phase E is complete with the retirement of the asset.

Phased Procurement Strategy. A full and open competition with more than one award for Phase B, competitions for subsequent phases involving the contractors from the preceding phase with award dependent on demonstrated completion of the requirements of the previous phase, and by progressively fewer awards for each sequential phase.

Program. A related series of undertakings that continue over a period of time (normally years), which are designed to pursue or are in support of a focused scientific or technical goal, and which are characterized by: design, development and operations of systems; relatively high funding levels; firm schedules; and firm technical and/or scientific objectives. Programs are typically planned and executed as a series of individual projects or as a group of projects to provide a major system capability.

Program Associate Administrator (PAA). The Headquarters official responsible and accountable for formulation and implementation of a major system program.

Program Commitment Agreement (PCA). The contract between the Administrator and the cognizant PAA for implementation of a major system program.

Program Cost Commitment (PCC). The cost ceiling established by the Administrator for the life cycle costs of a major system program.

Program Director. The Headquarters official who is responsible for the overall direction, control and oversight of a program for which implementation responsibility has been delegated to a program manager located at an HFI.

Program Management Council (PMC). The senior management group chaired by the Deputy Administrator responsible for integrated Agency-level program planning, recommending approval of proposed major system programs, and overseeing their implementation in accordance with Agency commitments, priorities, and policies.

Program Manager (Delegated Implementation Responsibility). The official at or in the vicinity of the HFI who has been delegated technical and fiscal resources management responsibility for the program.

Program Manager (Not Delegated Implementation Responsibility). The Headquarters official who is the focal point and serves as the external liaison for all Headquarters activities bearing on a project or group of projects for which implementation responsibility has been delegated to an FID.

Program Plan. The document that establishes the overall plan for implementation of a program. The Program Plan emphasizes the management aspects of the program rather than technical information and establishes the agreement between the PAA and the FID or the program manager at the HFI.

Program/Project Approval Review (PPAR). A review of a proposed new major system program or project by the Deputy Administrator/PMC for the purpose of securing their recommendation for:

(1) Approval to initiate a Phase B effort and its relative priority; or

(2) Approval to proceed to Phase C/D.

Program/Project Formulation. Those Preliminary Analysis (Phase A) and Definition (Phase B) efforts necessary to define the program sufficiently to obtain full ATP from Congress to proceed to

Program/Project Implementation.

Program/Project Implementation. Those Design (Phase C), Development (Phase D), and Operations (Phase E) efforts necessary to accomplish the objectives of an approved program/project.

Program/Project Management Steering Group (PPMSG). A group comprised of senior Headquarters and field installation program/project managers that support the Deputy Administrator/PMC in addressing program/project management policy, procedures, and related issues.

Progressive Competition. A phased procurement strategy that eliminates the need for a new, formal solicitation for each phase of a major system program/project by including a description of the subsequent phase competitions planned by the Government in the initial solicitation and contracts.

Project. A defined, time-limited activity with clearly established objectives and boundary conditions executed to gain knowledge, create a capability, or provide a service as part of an overall development program. A project typically encompasses design, development, fabrication, test, and as applicable, operation of advanced hardware and software, including data collection, distribution, and analysis and reporting of results.

Project Manager. The field installation official who is exclusively responsible for project definition and implementation to completion within a given set of boundary conditions (technical, cost, schedule and organization approach).

Project Plan. The document prepared by the field installation that establishes the overall plan for implementation of the project. The Project Plan emphasizes the management and programmatic aspects of the project rather than technical information, and establishes the agreement(s) between the PAA and the involved FID(s) (Single Field Installation Programs), or between the program manager at the HFI and the field installation project managers (Multiple Field Installation Programs).

Project Status Report (PSR). A semiannual status report to requesting Congressional committees for each major system project whose DCC exceeds $200M. The report highlights progress and problems and tracks cost, funding, schedule and performance of the project.

Prototype Test. An approach to qualifying space flight systems that uses qualification levels and duration's. The test is accomplished on flight identical hardware usually not intended for flight without further certification.

Qualification. Determination by a series of documented tests and analyses that a part, component, subsystem or system built to approved specifications is capable of meeting prescribed

performance requirements.

Qualification by Similarity. The procedure of comparing an item to another item having only minor differences in configuration and functional characteristics which has been: tested to stress levels at least as severe as those specified for the item to be qualified; tested under equivalent program controls; manufactured by the same supplier using similar processes, materials and quality control; and used in a similar application. The item also may be identical to one previously qualified and successfully flown.

Risk. The likelihood of an undesirable event occurring and the severity of the consequences of the occurrence.

Reserves. The APA and Contingency resources allocated to the cognizant Headquarters and field installation offices respectively.

Supporting Associate Administrator (SAA). An Headquarters AA responsible for committing and providing a system element(s) and/or support service needed by a PAA to commit to and implement a major system program.

System. The combination of elements that must function together to produce the capability required to meet the mission need. The elements include all hardware, software, equipment, facilities, personnel, and the processes and procedures needed for this purpose.

Technical Data. Includes all engineering drawings, associated lists, process descriptions, and other documents which define the physical geometry, material composition, performance characteristics, manufacture, assembly, and acceptance test procedures.

Threshold Requirement. A requirement which, if not met, would result in the basic mission objective not being achieved, or the mission need not being satisfied.

Undistributed Costs. Costs that cannot be clearly attributable to a unique program or project, but are necessary to the formulation and implementation of NASA major system programs and projects.

Verification. A process using test, analysis, and/or inspection to confirm that a system and its hardware and software components satisfy all specified performance and operational requirements.

APPENDIX B

ACRONYMS

AA	Associate Administrator
AO	Announcement of Opportunity
APA	Allowance for Program Adjustment
ASM	Acquisition Strategy Meeting
ATP	Authority to Proceed
C of F	Construction of Facilities
CDR	Critical Design Review
CFO	Chief Financial Officer
CM	Configuration Management
CMR	Contractor Metrics Report
COFR	Certification of Flight Readiness
CR	Cancellation Review
CWBS	Contract Work Breakdown Structure
DCC	Development Cost Commitment
DOD	Department of Defense
DR	Decommissioning Review
DRD	Data Requirements Description
EA	Environmental Assessment
EAC	Estimate at Completion
EIS	Environmental Impact Statement
FAR	Federal Acquisition Regulation
FMEA	Failure Modes and Effects Analysis
FID	Field Installation Director
FRR	Flight Readiness Review
FY	Fiscal Year
GAO	General Accounting Office
HFI	Host Field Installation
HR	Hazard Reports
IAA	Institutional Associate Administrator
IAR	Independent Annual Review
ICE	Independent Cost Estimate
ILS	Integrated Logistics Support
INSRP	Interagency Nuclear Safety Review Panel
IPMS	Integrated Program Master Schedule
IPS	Integrated Program/Project Summary
L-1	One year prior to launch
L-2	Two years prior to launch
LCC	Life Cycle Cost
LSRR	Launch Site Readiness Review
MNS	Mission Need Statement
MO&DA	Mission Operations & Data Analysis
MR	Mission Review
NAR	Non-Advocate Review
NEPA	National Environmental Policy Act
NFS	NASA FAR Supplement
NHB	NASA Handbook
NMI	NASA Management Instruction
NOA	New Obligation Authority

NRC	Nuclear Regulatory Commission
OMB	Office of Management and Budget
ORR	Operational Readiness Review
OSTP	Office of Science and Technology Policy
PAA	Program Associate Administrator
PBS	Product Breakdown Structure
PCA	Program Commitment Agreement
PCC	Program Cost Commitment
PDR	Preliminary Design Review
PMC	Program Management Council
POP	Program Operating Plan
PPAR	Program/Project Approval Review
PPM	Program/Project Management
PPMSG	Program/Project Management Steering Group
PSR	Project Status Reports
PSSP	Project System Safety Panel
QA	Quality Assurance
QSR	Quarterly Status Reviews
R&T	Research & Technology
RFP	Request for Proposal
RM	Resources Management
ROD	Record of Decision
RTOP	Research and Technology Objective and Plan
SAR	System Acceptance Review/Safety Analysis Report
SDR	System Design Review
SE&I	Systems Engineering & Integration
SEB	Source Evaluation Board
SEMP	Systems Engineering Management Plan
SM	Schedule Management
SMP	Safety Management Plan/Software Management Plan
SPPR	Special Program/Project Review
SRR	System Requirements Review
SSM	System Safety Manager
TDA	Tracking & Data Acquisition
TPM	Technical Performance Measures
UPN	Unique Project Number
V&V	Verification and Validation
WBS	Work Breakdown Structure